

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>7</sup> :</b> <b>C12N 15/12, 5/10, 1/21, C07K 14/52, 16/22, G01N 33/50, 33/566, A01K 67/027, A61K 31/70, 38/18, 39/395, A61P 9/00</b>		<b>A2</b>	<b>(11) International Publication Number:</b> <b>WO 00/37641</b>
			<b>(43) International Publication Date:</b> 29 June 2000 (29.06.00)
<b>(21) International Application Number:</b> PCT/US99/30503		<b>view Road, Skillman, NJ 08558 (US). DHANARAJ, Sridevi, Naidu [IN/US]; Johnson &amp; Johnson Consumer Products, Wound Healing Technology Resource Center, RG24, North Building, 199 Grandview Road, Skillman, NJ 08558 (US); XU, Jean [CN/US]; Johnson &amp; Johnson Consumer Products, Wound Healing Technology Resource Center, RG24, North Building, 199 Grandview Road, Skillman, NJ 08558 (US).</b>  <b>(74) Agent:</b> VAN AMSTERDAM, John, R.; Wolf, Greenfield & Sacks, P.C., 600 Atlantic Avenue, Boston, MA 02210 (US).	
<b>(22) International Filing Date:</b> 21 December 1999 (21.12.99)			
<b>(30) Priority Data:</b> 9828377.3                      22 December 1998 (22.12.98)      GB 60/124,967                    18 March 1999 (18.03.99)        US 60/164,131                    8 November 1999 (08.11.99)      US			
<b>(71) Applicant (for all designated States except US):</b> JANSSEN PHARMACEUTICA N.V. [BE/BE]; Turnhoutseweg 30, B-2340 Beerse (BE).			
<b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> GORDON, Robert, Douglas [GB/BE]; Janssen Pharmaceutica N.V., Turnhoutseweg 30, B-2340 Beerse (BE). SPRENGEL, Jorg, Jurgen [DE/BE]; Janssen Pharmaceutica N.V., Turnhoutseweg 30, B-2340 Beerse (BE). YON, Jeffrey, Roland [GB/BE]; Janssen Pharmaceutica N.V., Turnhoutseweg 30, B-2340 Beerse (BE). DIJKMANS, Josiena, Johanna, Huberdina [NL/BE]; Janssen Pharmaceutica N.V., Turnhoutseweg 30, B-2340 Beerse (BE). GOSIEWSKA, Anna [PL/US]; Johnson & Johnson Consumer Products, Wound Healing Technology Resource Center, RG24, North Building, 199 Grand-			
		<b>(81) Designated States:</b> AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
		<b>Published</b> <i>Without international search report and to be republished upon receipt of that report.</i> <i>With an indication in relation to deposited biological material furnished under Rule 13bis separately from the description.</i>	
<b>(54) Title:</b> VASCULAR ENDOTHELIAL GROWTH FACTOR-X			
<b>(57) Abstract</b>  There is provided a novel vascular endothelial growth factor, herein designated VEGF-X, in addition to the nucleic acid molecule encoding it, a host cell transformed with said vector and compounds which inhibit or enhance angiogenesis. Also provided is the sequence of a CUB domain present in the sequence of VEGF-X which domain itself prevents angiogenesis and which is used to treat diseases associated with inappropriate vascularisation or angiogenesis.			

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

- 1 -

**VASCULAR ENDOTHELIAL GROWTH FACTOR-X**

The present invention is concerned with a novel vascular endothelial growth factor (VEGF) herein designated "VEGF-X", and characterisation of the nucleic acid and amino acid sequences of VEGF-X.

**Introduction**

Angiogenesis involves formation and proliferation of new blood vessels, and is an essential physiological process for normal growth and development of tissues in, for example, embryonic development, tissue regeneration and organ and tissue repair.

Angiogenesis also features in the growth of human cancers which require continuous stimulation of blood vessel growth. Abnormal angiogenesis is associated with other diseases such as rheumatoid arthritis psoriasis and diabetic retinopathy.

Capillary vessels consist of endothelial cells which carry the genetic information necessary to proliferate to form capillary networks. Angiogenic molecules which can initiate this process have previously been characterised. A highly selective mitogen for vascular endothelial cells is vascular endothelial growth factor (VEGF) (Ferrara et al., "Vascular Endothelial Growth Factor: Basic Biology and Clinical Implications". Regulation of angiogenesis, by I.D. Goldberg and E.M. Rosen 1997 Birkhauser Verlag Basle/Switzerland). VEGF is a potent vasoactive protein which is comprised of a glycosylated cationic 46-49 kd dimer having two 24 kd subunits. It is inactivated by sulfhydryl reducing agents and is resistant to acidic pH and to heating and binds to immobilised heparin.

VEGF-A has four different forms of 121, 165, 189 and 206 amino acids respectively due to alternative splicing. VEGF121 and VEGF165 are soluble and are capable of promoting angiogenesis, whereas VEGF189 and VEGF206 are bound to heparin containing proteoglycans in the cell surface. The temporal and spatial expression of VEGF has been correlated with physiological proliferation of the blood vessels (Gajdusek, C.M., and Carbon, S.J., Cell Physiol., 139:570-579, (1989)); McNeil, P.L., Muthukrishnan, L., Warder, E., D'Amore, P.A., J. Cell. Biol., 109:811-822, (1989)). Its high affinity binding sites are localized only on endothelial cells in tissue sections (Jakeman, L.B., et al., Clin. Invest. 89:244-253 (1989)). The growth factor can be isolated from pituitary cells and several tumor cell lines, and has been implicated in some human gliomas (Plate, K.H. Nature 359:845-848, (1992)). The inhibition of VEGF function by anti-VEGF monoclonal antibodies was shown to inhibit tumor growth in immune-deficient mice (Kim, K.J., Nature 362:841-844, (1993)).

VEGF proteins have been described in the following patents and applications all of which are hereby incorporated by reference EP-0,506,477, WO-95/24473, WO-98/28621, WO-90/13649, EP-0,476,983, EP-0,550,296, WO-90/13649, WO-96/26736, WO-96/27007, WO-98/49300, WO-98/36075, WO-98/840124, WO-90/11084, WO-98/24811, WO-98/10071, WO-98/07832, WO-98/02543, WO-97/05250, WO-91/02058, WO-96/39421, WO-96/39515, WO-98/16551.

The present inventors have now identified a further vascular endothelial growth factor, designated herein as "VEGF-X", and the nucleic acid sequence encoding it, which has potentially significant benefits for the treatment of tumours and other conditions mediated by inappropriate angiogenic activity.

Summary of the Invention

In the present application, there is provided a novel vascular endothelial growth factor, herein designated "VEGF-X", nucleic acid molecules encoding said growth factor, an expression vector comprising said nucleic acid molecule, a host cell transformed with said vector and compounds which inhibit or enhance angiogenesis. Also provided is the sequence of a CUB domain present in the sequence of VEGF-X which domain itself prevents angiogenesis and which is used to treat diseases associated with inappropriate vascularisation or angiogenesis.

Detailed Description of the Invention

Therefore, according to a first aspect of the present invention there is provided a nucleic acid molecule encoding a VEGF-X protein or a functional equivalent, fragment, derivative or bioprecursor thereof, said protein comprising the amino acid sequence from position 23 to 345 of the amino acid sequence illustrated in Figure 10. Alternatively, the nucleic acid molecule of the invention encodes the complete sequence identified in Figure 10 and which advantageously includes a signal peptide to express said protein extracellularly. Preferably, the nucleic acid molecule is a DNA and even more preferably a cDNA molecule. Preferably, the nucleic acid molecule comprises the nucleotide sequence from position 257 to 1291 of the nucleotide sequence illustrated in Figure 9. In a preferred embodiment the nucleic acid is of mammalian origin and even more preferably of human origin.

In accordance with the present invention a functional

- 4 -

equivalent should be taken to mean a protein, or a sequence of amino acids that have similar function to the VEGF-X protein of the invention.

5 Also provided by this aspect of the present invention is a nucleic acid molecule such as an antisense molecule capable of hybridising to the nucleic acid molecules according to the invention under high stringency conditions, which conditions would be well  
10 known to those skilled in the art.

Stringency of hybridisation as used herein refers to conditions under which polynucleic acids are stable. The stability of hybrids is reflected in the melting  
15 temperature ( $T_m$ ) of the hybrids.  $T_m$  can be approximated by the formula:

$$81.5^{\circ}\text{C} + 16.6(\log_{10}[\text{Na}^+] + 0.41 (\% \text{G\&C}) - 600/l$$

20 wherein  $l$  is the length of the hybrids in nucleotides.  $T_m$  decreases approximately by 1-1.5°C with every 1% decrease in sequence homology.

The term "stringency" refers to the hybridisation  
25 conditions wherein a single-stranded nucleic acid joins with a complementary strand when the purine or pyrimidine bases therein pair with their corresponding base by hydrogen bonding. High stringency conditions favour homologous base pairing whereas low stringency  
30 conditions favour non-homologous base pairing.

"Low stringency" conditions comprise, for example, a temperature of about 37°C or less, a formamide concentration of less than about 50%, and a moderate  
35 to low salt (SSC) concentration; or, alternatively, a temperature of about 50°C or less, and a moderate to high salt (SSPE) concentration, for example 1M NaCl.

- 5. -

"High stringency" conditions comprise, for example, a temperature of about 42°C or less, a formamide concentration of less than about 20%, and a low salt (SSC) concentration; or, alternatively, a temperature of about 65°C, or less, and a low salt (SSPE) concentration. For example, high stringency conditions comprise hybridization in 0.5 M NaHPO<sub>4</sub>, 7% sodium dodecyl sulfate (SDS), 1 mM EDTA at 65°C (Ausubel, F.M. et al. Current Protocols in Molecular Biology, Vol. I, 1989; Green Inc. New York, at 2.10.3).

"SSC" comprises a hybridization and wash solution. A stock 20X SSC solution contains 3M sodium chloride, 0.3M sodium citrate, pH 7.0.

"SSPE" comprises a hybridization and wash solution. A 1X SSPE solution contains 180 mM NaCl, 9mM Na<sub>2</sub>HPO<sub>4</sub> and 1 mM EDTA, pH 7.4.

The nucleic acid capable of hybridising to nucleic acid molecules according to the invention will generally be at least 70%, preferably at least 80 or 90% and more preferably at least 95% homologous to the nucleotide sequences according to the invention.

The antisense molecule capable of hybridising to the nucleic acid according to the invention may be used as a probe or as a medicament or may be included in a pharmaceutical composition with a pharmaceutically acceptable carrier, diluent or excipient therefor.

The term "homologous" describes the relationship between different nucleic acid molecules or amino acid sequences wherein said sequences or molecules are related by partial identity or similarity at one or more blocks or regions within said molecules or

- 6 -

sequences.

The present invention also comprises within its scope proteins or polypeptides encoded by the nucleic acid  
5 molecules according to the invention or a functional equivalent, derivative or bioprecursor thereof.

Therefore, according to a further aspect of the present invention, there is provided a VEGF-X protein,  
10 or a functional equivalent, derivative or bioprecursor thereof, comprising an amino acid sequence from position 23 to 345 of the sequence as illustrated in Figure 10, or alternatively which amino acid sequence comprises the complete sequence of Figure 10. A  
15 further aspect of the invention comprises a VEGF-X protein, or a functional equivalent, derivative or bioprecursor thereof, encoded by a nucleic acid molecule according to the invention. Preferably, the VEGF-X protein encoded by said nucleic acid molecule  
20 comprises the sequence from position 23 to 345 of the amino acid sequence as illustrated in Figure 10, or which sequence alternatively comprises the sequence of amino acids of Figure 10.

25 The DNA molecules according to the invention may, advantageously, be included in a suitable expression vector to express VEGF-X encoded therefrom in a suitable host. Incorporation of cloned DNA into a suitable expression vector for subsequent  
30 transformation of said cell and subsequent selection of the transformed cells is well known to those skilled in the art as provided in Sambrook et al. (1989), molecular cloning, a laboratory manual, Cold Spring Harbour Laboratory Press.

35 An expression vector according to the invention includes a vector having a nucleic acid according to



- 7 -

the invention operably linked to regulatory sequences, such as promoter regions, that are capable of effecting expression of said DNA fragments. The term "operably linked" refers to a juxtaposition wherein the components described are in a relationship permitting them to function in their intended manner. Such vectors may be transformed into a suitable host cell to provide for expression of a polypeptide according to the invention. Thus, in a further aspect, the invention provides a process for preparing polypeptides according to the invention which comprises cultivating a host cell, transformed or transfected with an expression vector as described above under conditions to provide for expression by the vector of a coding sequence encoding the polypeptides, and recovering the expressed polypeptides.

The vectors may be, for example, plasmid, virus or phage vectors provided with an origin of replication, and optionally a promoter for the expression of said nucleotide and optionally a regulator of the promoter.

The vectors may contain one or more selectable markers, such as, for example, ampicillin resistance.

Regulatory elements required for expression include promoter sequences to bind RNA polymerase and transcription initiation sequences for ribosome binding. For example, a bacterial expression vector may include a promoter such as the lac promoter and for translation initiation the Shine-Dalgarno sequence and the start codon AUG. Similarly, a eukaryotic expression vector may include a heterologous or homologous promoter for RNA polymerase II, a downstream polyadenylation signal, the start codon AUG, and a termination codon for detachment of the

- 8 -

ribosome. Such vectors may be obtained commercially or assembled from the sequences described by methods well known in the art.

5 Nucleic acid molecules according to the invention may be inserted into the vectors described in an antisense orientation in order to provide for the production of antisense RNA. Antisense RNA or other antisense nucleic acids may be produced by synthetic means.

10

In accordance with the present invention, a defined nucleic acid includes not only the identical nucleic acid but also any minor base variations including in particular, substitutions in cases which result in a  
15 synonymous codon (a different codon specifying the same amino acid residue) due to the degenerate code in conservative amino acid substitutions. The term "nucleic acid sequence" also includes the complementary sequence to any single stranded sequence  
20 given regarding base variations.

The present invention also advantageously provides nucleic acid sequences of at least approximately 10 contiguous nucleotides of a nucleic acid according to  
25 the invention and preferably from 10 to 50 nucleotides even more preferably, the nucleic acid sequence comprise the sequences illustrated in Figure 3. These sequences may, advantageously be used as probes or primers to initiate replication, or the like. Such  
30 nucleic acid sequences may be produced according to techniques well known in the art, such as by recombinant or synthetic means. They may also be used in diagnostic kits or the like for detecting the presence of a nucleic acid according to the invention.  
35 These tests generally comprise contacting the probe with the sample under hybridising conditions and detecting for the presence of any duplex or triplex

- 9 -

formation between the probe and any nucleic acid in the sample.

5 The nucleic acid sequences according to this aspect of the present invention comprise the sequences of nucleotides illustrated in Figures 3 and 5.

10 According to the present invention these probes may be anchored to a solid support. Preferably, they are present on an array so that multiple probes can simultaneously hybridize to a single biological sample. The probes can be spotted onto the array or synthesised *in situ* on the array. (See Lockhart et al., Nature Biotechnology, vol. 14, December 1996

15 "Expression monitoring by hybridisation to high density oligonucleotide arrays". A single array can contain more than 100, 500 or even 1,000 different probes in discrete locations.

20 The nucleic acid sequences, according to the invention may be produced using such recombinant or synthetic means, such as for example using PCR cloning mechanisms which generally involve making a pair of primers, which may be from approximately 10 to 50

25 nucleotides to a region of the gene which is desired to be cloned, bringing the primers into contact with mRNA, cDNA, or genomic DNA from a human cell, performing a polymerase chain reaction under conditions which brings about amplification of the

30 desired region, isolating the amplified region or fragment and recovering the amplified DNA. Generally, such techniques are well known in the art, such as described in Sambrook et al. (Molecular Cloning: a Laboratory Manual, 1989).

35 The nucleic acids or oligonucleotides according to the invention may carry a revealing label. Suitable

- 10 -

labels include radioisotopes such as  $^{32}\text{P}$  or  $^{35}\text{S}$ , enzyme labels or other protein labels such as biotin or fluorescent markers. Such labels may be added to the nucleic acids or oligonucleotides of the invention and  
5 may be detected using known techniques *per se*.

Advantageously, human allelic variants or polymorphisms of the DNA molecule according to the invention may be identified by, for example, probing  
10 cDNA or genomic libraries from a range of individuals, for example, from different populations. Furthermore, nucleic acids and probes according to the invention may be used to sequence genomic DNA from patients using techniques well known in the art, such as the  
15 Sanger Dideoxy chain termination method, which may, advantageously, ascertain any predisposition of a patient to certain disorders associated with a growth factor according to the invention.

20 The protein according to the invention includes all possible amino acid variants encoded by the nucleic acid molecule according to the invention including a polypeptide encoded by said molecule and having conservative amino acid changes. Conservative amino  
25 acid substitution refers to a replacement of one or more amino acids in a protein as identified in Table 1. Proteins or polypeptides according to the invention further include variants of such sequences, including naturally occurring allelic variants which are  
30 substantially homologous to said proteins or polypeptides. In this context, substantial homology is regarded as a sequence which has at least 70%, preferably 80 or 90% and preferably 95% amino acid homology with the proteins or polypeptides encoded by  
35 the nucleic acid molecules according to the invention. The protein according to the invention may be recombinant, synthetic or naturally occurring, but is

- 11 -

preferably recombinant.

5 The nucleic acid or protein according to the invention may be used as a medicament or in the preparation of a medicament for treating cancer or other diseases or conditions associated with expression of VEGF-X protein.

10 Advantageously, the nucleic acid molecule or the protein according to the invention may be provided in a pharmaceutical composition together with a pharmacologically acceptable carrier, diluent or excipient therefor.

15 The present invention is further directed to inhibiting VEGF-X *in vivo* by the use of antisense technology. Antisense technology can be used to control gene expression through triple-helix formation of antisense DNA or RNA, both of which methods are  
20 based on binding of a polynucleotide to DNA or RNA. For example, the 5' coding portion or the mature DNA sequence, which encodes for the protein of the present invention, is used to design an antisense RNA oligonucleotide of from 10 to 50 base pairs in length.  
25 A DNA oligonucleotide is designed to be complementary to a region of the gene involved in transcription (triple-helix - see Lee et al. Nucl. Acids Res., 6:3073 (1979); Cooney et al., Science, 241:456 (1988); and Dervan et al., Science, 251: 1360 (1991), thereby  
30 preventing transcription and the production of VEGF-X. The antisense RNA oligonucleotide hybridises to the mRNA *in vivo* and blocks translation of an mRNA molecule into the VEGF-X protein (antisense - Okano, J. Neurochem., 56:560 (1991); Oligodeoxynucleotides as  
35 Antisense Inhibitors of Gene Expression, CRC Press, Boca Raton, FL (1988)).

- 12 -

Alternatively, the oligonucleotide described above can be delivered to cells by procedures in the art such that the anti-sense RNA and DNA may be expressed in vivo to inhibit production of VEGF-X in the manner described above.

Antisense constructs to VEGF-X, therefore, may inhibit the angiogenic activity of VEGF-X and prevent the further growth of or even regress solid tumours, since angiogenesis and neovascularization are essential steps in solid tumour growth. These antisense constructs may also be used to treat rheumatoid arthritis, psoriasis and diabetic retinopathy which are all characterized by abnormal angiogenesis.

A further aspect of the invention provides a host cell or organism, transformed or transfected with an expression vector according to the invention. The host cell or organism may advantageously be used in a method of producing VEGF-X, which comprises recovering any expressed VEGF-X from the host or organism transformed or transfected with the expression vector.

According to a further aspect of the invention there is also provided a transgenic cell, tissue or organism comprising a transgene capable of expressing VEGF-X protein according to the invention. The term "transgene capable of expression" as used herein means a suitable nucleic acid sequence which leads to expression of VEGF-X or proteins having the same function and/or activity. The transgene, may include, for example, genomic nucleic acid isolated from human cells or synthetic nucleic acid, including DNA integrated into the genome or in an extrachromosomal state. Preferably, the transgene comprises the nucleic acid sequence encoding the proteins according to the invention as described herein, or a functional

- 13. -

fragment of said nucleic acid. A functional fragment of said nucleic acid should be taken to mean a fragment of the gene comprising said nucleic acid coding for the proteins according to the invention or  
5 a functional equivalent, derivative or a non-functional derivative such as a dominant negative mutant, or bioprecursor of said proteins. For example, it would be readily apparent to persons skilled in the art that nucleotide substitutions or  
10 deletions may be used using routine techniques, which do not affect the protein sequence encoded by said nucleic acid, or which encode a functional protein according to the invention.

15 VEGF-X protein expressed by said transgenic cell, tissue or organism or a functional equivalent or bioprecursor of said protein also forms part of the present invention.

20 Antibodies to the protein or polypeptide of the present invention may, advantageously, be prepared by techniques which are known in the art. For example, polyclonal antibodies may be prepared by inoculating a host animal, such as a mouse or rabbit, with the  
25 polypeptide according to the invention or an epitope thereof and recovering immune serum. Monoclonal antibodies may be prepared according to known techniques such as described by Kohler R. and Milstein C., Nature (1975) 256, 495-497. Advantageously, such  
30 antibodies may be included in a kit for identifying VEGF-X in a sample, together with means for contacting the antibody with the sample.

35 Advantageously, the antibody according to the invention may also be used as a medicament or in the preparation of a medicament for treating tumours or other diseases associated with expression of VEGF-X.

- 14 -

The invention also further provides a pharmaceutical composition comprising said antibody together with a pharmaceutically acceptable carrier diluent or excipient therefor.

5

Proteins which interact with the polypeptide of the invention may be identified by investigating protein-interactions using the two-hybrid vector system first proposed by Chien et al., (1991) Proc. Natl. Acad. Sci. USA 88 : 9578-9582.

10

This technique is based on functional reconstitution in vivo of a transcription factor which activates a reporter gene. More particularly the technique comprises providing an appropriate host cell with a DNA construct comprising a reporter gene under the control of a promoter regulated by a transcription factor having a DNA binding domain and an activating domain, expressing in the host cell a first hybrid DNA sequence encoding a first fusion of a fragment or all of a nucleic acid sequence according to the invention and either said DNA binding domain or said activating domain of the transcription factor, expressing in the host at least one second hybrid DNA sequence, such as a library or the like, encoding putative binding proteins to be investigated together with the DNA binding or activating domain of the transcription factor which is not incorporated in the first fusion; detecting any binding of the proteins to be investigated with a protein according to the invention by detecting for the presence of any reporter gene product in the host cell; optionally isolating second hybrid DNA sequences encoding the binding protein.

15

20

25

30

35

An example of such a technique utilises the GAL4 protein in yeast. GAL4 is a transcriptional activator of galactose metabolism in yeast and has a separate



domain for binding to activators upstream of the galactose metabolising genes as well as a protein binding domain. Nucleotide vectors may be constructed, one of which comprises the nucleotide residues encoding the DNA binding domain of GAL4. These binding domain residues may be fused to a known protein encoding sequence, such as for example, the nucleic acids according to the invention. The other vector comprises the residues encoding the protein binding domain of GAL4. These residues are fused to residues encoding a test protein. Any interaction between polypeptides encoded by the nucleic acid according to the invention and the protein to be tested leads to transcriptional activation of a reporter molecule in a GAL-4 transcription deficient yeast cell into which the vectors have been transformed. Preferably, a reporter molecule such as  $\beta$ -galactosidase is activated upon restoration of transcription of the yeast galactose metabolism genes.

A further aspect of the present invention also provides a method of identifying VEGF-X in a sample, which method comprises contacting said sample with an antibody according to the invention and monitoring for any binding of any proteins to said antibody. A kit for identifying the presence of VEGF-X in a sample is also provided comprising an antibody according to the invention and means for contacting said antibody with said sample.

VEGF-X may be recovered and purified from recombinant cell cultures by methods known in the art, including ammonium sulfate or ethanol precipitation, acid extraction, anion or cation exchange chromatography, phosphocellulose chromatography, hydrophobic interaction chromatography, affinity chromatography, hydroxyapatite chromatography and lectin

- 16 -

chromatography.

5 The VEGF-X protein of the present invention may be a naturally purified product, or a product of chemical synthetic procedures, or produced by recombinant techniques from a prokaryotic or eukaryotic host (for example, by bacterial yeast, higher plant, insect and mammalian cells in culture). Depending upon the host employed in a recombinant production procedure, the  
10 polypeptides of the present invention may be glycosylated with mammalian or other eukaryotic carbohydrates or may be non-glycosylated.

15 VEGF-X is particularly advantageous as a wound healing agent, where, for example, it is necessary to re-vascularize damaged tissues, or where new capillary angiogenesis is important. Accordingly, VEGF-X may be used for treatment of various types of wounds such as for example, dermal ulcers, including pressure sores,  
20 venous ulcers, and diabetic ulcers. In addition, it can be used in the treatment of full-thickness burns and injuries where angiogenesis is desired to prepare the burn in injured sites for a skin graft and flap. In this case, VEGF-X or the nucleic acid encoding it  
25 may be applied directly to the wound. VEGF-X may be used in plastic surgery when reconstruction is required following a burn, other trauma, or even for cosmetic purposes.

30 An important application of VEGF-X is to induce the growth of damaged bone, periodontium or ligament tissue. For example, it may be used in periodontal disease where VEGF-X is applied to the roots of the diseased teeth, leading to the formation of new bone  
35 and cementum with collagen fibre ingrowths. It can be used for regenerating supporting tissues of teeth, including alveolar bone, cementum and periodontal

- 17 -

ligament, that have been damaged by disease and trauma.

5 Since angiogenesis is important in keeping wounds clean and non-infected, VEGF-X may be used in association with surgery and following the repair of cuts. It should be particularly useful in the treatment of abdominal wounds where there is a high risk of infection.

10 VEGF-X can also be used for the promotion of endothelialization in vascular graft surgery. In the case of vascular grafts using either transplanted or synthetic material, VEGF-X may be applied to the  
15 surface of the graft or at the junction to promote the growth of the vascular endothelial cells. One derivation of this is that VEGF-X can be used to repair the damage of myocardial and other occasions where coronary bypass surgery is needed by stimulating  
20 the growth of the transplanted tissue. Related to this is the use of VEGFX to repair the cardiac vascular system after ischemia.

25 The protein of the present invention may also be employed in accordance with the present invention by expression of such protein in vivo, which is often referred to as "gene therapy".

30 Thus, for example, cells such as bone marrow cells may be engineered with a polynucleotide (DNA or RNA) encoding for the protein ex vivo as defined herein, the engineered cells are then provided to a patient to be treated with the polypeptide. Such methods are well-known in the art. For example, cells may be  
35 engineered by procedures known in the art by use of a retroviral particle containing RNA encoding for the protein of the present invention.

- 18 -

Similarly, cells may be engineered *in vivo* for expression of the protein *in vivo*, for example, by procedures known in the art.

5 A further aspect of the invention comprises a method of treating a disorder mediated by expression of a protein according to the invention, by administering to a patient an amount of an antisense molecule as described herein, in sufficient concentration to  
10 alleviate or reduce the symptoms of said disorder.

Compounds which inhibit or enhance angiogenesis may be identified by providing a host cell or organism according to the invention or a transgenic cell,  
15 tissue or organism according to the invention, contacting a test compound with said cell, tissue or organism and monitoring for the effect of said compound compared to a cell tissue or organism which has not been contacted with said compound. These  
20 compounds may themselves be used as a medicament or included in a pharmaceutical composition for treatment of disorders mediated by inappropriate vascularisation or angiogenic activity.

25 The present inventors have also, advantageously, identified in the sequence encoding the VEGF-X protein a CUB domain, which has heretofore not previously been identified in VEGF-type growth factors. The VEGF-X protein may therefore exert dual regulatory effects  
30 via interaction with the VEGF tyrosine kinase receptors or with neuropilin receptors mediated by the CUB domain. Thus, the sequence encoding said CUB domain may be included in an expression vector for subsequent transformation of a host cell, tissue or  
35 organism.

VEGF-X or fragments thereof may be able to modulate

- 19 -

the effects of pro-angiogenic growth factors such as VEGF as indicated in the findings presented in the examples below that the N-terminal part of the VEGF-X protein, a CUB-like domain, is able to inhibit VEGF-stimulated proliferation of HUVECs. VEGF-X or fragments thereof may therefore be useful in therapy of conditions involving inappropriate angiogenesis. Inhibition of the angiogenic activity of VEGF has been linked with inhibition of tumour growth in several models eg Kim K. J. et al, Nature 362:841-844, (1993). Additionally, agents able to inhibit angiogenesis would be expected to be useful in treating other angiogenesis-dependent diseases such as retinopathy, osteoarthritis and psoriasis (Folkman, J., Nature Medicine 1:27-31, (1995)).

As identified in more detail in the Examples described herein the present inventors have surprisingly identified that the CUB domain of VEGF-X is able to inhibit stimulation of proliferation of HUVECs induced by either VEGF or bFGF. The CUB domain may, therefore, be utilised as a therapeutic agent for inhibition of angiogenesis and for treatment of condition associated with inappropriate vascularisation or angiogenesis.

Therefore according to a further aspect of the invention there is provided a method of inhibiting angiogenic activity and inappropriate vascularisation including formation and proliferation of new blood vessels, growth and development of tissues, tissue regeneration and organ and tissue repair in a subject said method comprising administering to said subject an amount of a polypeptide having an amino acid sequence from position 40 to 150 of the sequence illustrated in Figure 10 or a nucleic acid molecule encoding the CUB domain according to the invention in

- 20 -

sufficient concentration to reduce or prevent said angiogenic activity.

5 Furthermore there is also provided a method of  
treating or preventing any of cancer, rheumatoid  
arthritis, psoriasis and diabetic retinopathy, said  
method comprising administering to said subject an  
amount of a polypeptide having an amino acid sequence  
10 in Figure 10 or a nucleic acid molecule encoding the  
CUB domain according to the invention in sufficient  
concentration to treat or prevent said disorders.

15 The CUB domain may also be used to identify compounds  
that inhibit or enhance angiogenic activity such as  
inappropriate vascularisation, in a method comprising  
contacting a cell expressing a VEGF receptor and/or a  
neuropilin 1 or 2 type receptor with said compound in  
20 the presence of a VEGF-X protein according to the  
invention and monitoring for the effect of said  
compound or said cell when compared to a cell which  
has not been contacted with said compound. Such  
compounds may then be used as appropriate to prevent  
or inhibit angiogenic activity to treat the disorders  
25 or conditions described herein, or in a  
pharmaceutical composition. An antibody to said CUB  
domain may also be useful in identifying other  
proteins having said sequences.

30

35

Deposited Plasmids

		<u>Date of Deposit</u>	<u>Accession No.</u>
5	Plasmid VEGFX/PCR2.1 1TOPO FL	1 March 1999	LMBP 3925
10	Plasmid VEGFX/pRSETB BD amino acids G230-G345	1 March 1999	LMBP 3926
	Plasmid VEGFX/PCR.2.1 FL Clone 9	20 October 1999	LMBP 3977
15	Plasmid VEGF-X CUB PET22b	20 December 1999	-----

20 The above plasmids were deposited at the Belgian Coordinated Collections of Microorganisms (BCCM) at Laboratorium Voor Moleculaire Biologie-Plasmidencollectie (LMBP) B-9000, Ghent, Belgium, in accordance with the provisions of the Budapest Treaty of 28 April 1977.

25 The invention may be more clearly understood with reference to the accompanying example, which is purely exemplary, with reference to the accompanying drawings, wherein:

30 Figure 1: is a DNA sequence identified in the Incyte LifeSeq™ database coding for a novel VEGF-X protein.

35 Figure 2: is an illustration of amino acid sequence of the nucleic acid sequence of Figure 1.

- 22 -

- Figure 3: is an illustration of PCR primer sequences utilised to identify the VEGF-X protein according to the invention.
- 5
- Figure 4: is a diagrammatic illustration of the spatial relationships in the VEGF-X sequence of the clones identified using the PCR primer sequences of Figure 3.
- 10
- Figure 5: is an illustration of the nucleotide sequences of the 5' RACE primers used to identify the 5' end of the VEGF-X open reading frame.
- 15
- Figure 6: is an illustration of the sequence obtained from the RACE experiment.
- 20
- Figure 7: is an illustration of the nucleotide sequences obtained from the search of LifeSeq™ database using the sequence in Figure 6.
- 25
- Figure 8: is an illustration of the primers used to clone the entire coding sequence of VEGF-X.
- 30
- Figure 9: is an illustration of the entire coding sequence of VEGF-X.
- Figure 10: is an illustration of the predicted amino acid sequence of the nucleotide sequence of Figure 9.
- 35
- Figure 11: is an alignment of the sequence of



Figure 10 with the sequences of VEGF-A to D.

- 5      Figure 12:      is an illustration of variant sequences of the VEGF-X protein according to the invention.
- 10      Figure 13:      is an illustration of the oligonucleotide primers used for E.coli expression of VEGF-X domains and for expression of the full length sequence of VEGF-X in a baculovirus/insect cell expression system.
- 15      Figure 14:      depicts nucleic acid sequences of 18 human EST clones obtained from a BLAST search of the LifeSeq™ database used to identify the full sequence encoding VEGF-X.
- 20      Figure 15:      depicts the nucleotide sequences of 50 human EST clones obtained from the LifeSeq™ database.
- 25      Figure 16:      is an illustration of nucleotide sequences utilised as primers to identify the nucleotide sequence encoding VEGF-X.
- 30      Figure 17:      is a nucleotide sequence coding for a partial VEGF-X protein according to the invention.
- 35      Figure 18:      is an illustration of a partial nucleotide sequence encoding VEGF-X protein according to the invention.

- Figure 19: is an illustration of a DNA and polypeptide sequence used for mammalian cell expression of VEGF-X. The predicted VEGF-X signal sequence is in lower case letters. The C-terminal V5 epitope and His6 sequences are underlined.
- Figure 20: is an illustration of a DNA and polypeptide sequence used for baculovirus/insect cell expression of VEGF-X. In the polypeptide sequence the signal sequence is shown in lower case. The N-terminal peptide tag added to the predicted mature VEGF-X sequence is underlined.
- Figure 21: is an illustration of a DNA and polypeptide sequence used for *E. coli* expression of VEGF-X. The polypeptide sequences at the N- and C- termini derived from the MBP fusion and His6 tag respectively are underlined.
- Figure 22: illustrates the disulphide-linked dimerisation of VEGF-X. Protein samples were analysed by SDS-PAGE. Prior to loading the gel, samples were heated to 95°C for 5 minutes in sample buffer in the presence (+) or absence (-) of reducing agent. (A) samples from COS cell expression of a C-terminally V5/His6 peptide-tagged construct. The left hand panel is total conditioned medium, the right hand panel is material purified on Nickel agarose resin. Reduced monomer

- 25 -

5 and putative disulphide-linked, non-reduced dimer are indicated by arrows. There appears to be proteolysis of the protein during purification. Gels were blotted onto nylon membranes and protein detected with an anti V5 monoclonal antibody. (B) Samples from *E. coli* expression of a maltose-binding protein/His6 dual fusion construct. M indicates the molecular weight markers (Benchmark, LifeTechnologies). The gel was stained with Coomassie Blue by standard procedures. The fusion protein has an apparent molecular weight of 80kDa.

10

15

Figure 23: illustrates the glycosylation of VEGF-X. VEGF-X was purified from the culture supernatant of COS cells transfected with the pcDNA6/V5-His construct. Supernatants were harvested 72h post-transfection and purified on nickel resin. Samples were then treated with EndoH (+) or untreated (-) before SDS-PAGE and blotting, as described in the legend to Figure 22.

20

25

Figure 24: is an illustration of the DNA and polypeptide sequence used for *E. coli* expression of the VEGF-like domain of VEGF-X. Polypeptide sequences at the N-terminus of the protein derived from the vector are underlined.

30

Figure 25: shows expression of the VEGF-X VEGF domain in *E. coli*. Lane 1-10µl broad

35

- 26 -

range marker (New England Biolabs),  
lane 2-10 $\mu$ l unreduced sample, lane 3-  
10 $\mu$ l reduced sample. The reduced PDGF  
domain protein (lane 3) has an  
apparent molecular weight of  
approximately 19kDa on SDS-PAGE.

Figure 26: illustrates a DNA and polypeptide  
sequence used for *E. coli* expression  
of the CUB-like domain of VEGF-X. The  
polypeptide sequence at the N-terminus  
derived from the vector-encoded signal  
and the introduced His6 tag are  
underlined.

Figure 27: shows expression of the VEGF-X CUB  
domain in *E. coli*. The CUB domain  
protein was purified on Nickel chelate  
resin. The protein migrates at  
approximately 23kDa on SDS-PAGE.

Figure 28: illustrates the effect of truncated  
VEGF-X (CUB domain) on HUVEC  
proliferation. (A) Human Umbilical  
Vein Endothelial Cells (one-day-  
treatment). (B) Human Umbilical Vein  
Endothelial Cells (24-hour starving  
followed by one-day-treatment). (C)  
Effect of VEGF-A<sub>165</sub> and VEGF-X CUB  
domain on the proliferation of HUVEC  
(two-day-treatment).

Figure 29: depicts the tissue distribution of  
VEGF-X mRNA analysed by Northern  
blotting and RT-PCR in (A) normal  
tissues and (B) tumour tissue and cell  
lines.

Figure 30: depicts the partial intron/exon structure of the VEGF-X gene. (A) Genomic DNA sequences of 2 exons determined by sequencing; exon sequence is in upper case, intron sequence is in lower case. (B) Shows the location of splice sites within the VEGF-X cDNA sequence. The location of mRNA splicing events is indicated by vertical lines. The cryptic splice donor/acceptor site at nt. 998/999 (diagonal lines) gives rise to the splice variant forms of VEGF-X. No splice site information is given for the region shown in italics.

Figure 31: is a graphic representation of the effect of FL-VEGF-X on HuVEC proliferation: (24 hour serum starvation followed by one day treatment).

Figure 32: is a graphic representation of the combined effect of truncated VEGF-X (CUB domain) and human recombinant VEGF<sub>165</sub> on HuVEC proliferation: (24 hour serum starvation followed by two day treatment).

Figure 33: is a graphic representation of the combined effect of the CUB domain and human recombinant bFGF on HuVEC proliferation: (24 hour serum starvation followed by two day treatment).

Figure 34: is a graphic representation of the

- 28 -

results of a LDH assay for testing cytotoxicity of the CUB domain or the CUB domain with rhVEGF<sub>165</sub>.

- 5     Figure 35:     is a graphic representation of the results obtained from a LDH assay for testing cytotoxicity of the CUB domain or CUB domain with rh-bFGF.
- 10    A BLAST (Basic Local Alignment Search Tool; Altschul et al., 1990 J. Mol. Biol. 215, 403-410) search was performed in the proprietary LifeSeq™ human EST database (Incyte Pharmaceuticals, Inc., Palo Alto, CA, USA). BLAST produces alignments of both
- 15    nucleotide and amino acid sequences to determine sequence similarity. Because of the local nature of the alignments, BLAST is especially useful in determining exact matches or in identifying homologues. While it is useful for matches which do
- 20    not contain gaps, it is inappropriate for performing motif-style searching. The fundamental unit of BLAST algorithm output is the High-scoring Segment Pair (HSP).
- 25    Eighteen human EST clones (Figure 14) with high similarity to the previously identified VEGF proteins were identified and a further fifty EST clones (Figure 15) were identified using these sequences as query sequences, allowing us to deduce the putative
- 30    sequence for the new VEGF-X protein. The sequences obtained were compared to known sequences to determine regions of homology and to identify the sequence as a novel VEGF-type protein. Using the DNA sequence information in the databases we were able to
- 35    prepare suitable primers having the sequences of VEGF-X 1-10 illustrated in Figure 3 for use in subsequent RACE experiments to obtain the complete

- 29 -

DNA sequence for the VEGF-X gene.

#### Cloning

5 A profile was developed based on the VEGF-like domain,  
in existing VEGF sequences (VEGF-A, B, C and D).  
This was used to search the public databases and the  
Incyte LifeSeq™ database. No significant novel  
10 matching sequences were found in the public  
databases. All of the matching sequences found in  
the LifeSeq™ database (~1000) were assembled to give  
a smaller number of sequences (~30), which included  
the known VEGFs and a potential novel VEGF (figures  
1 and 2). This sequence was named VEGF-X.  
15  
Oligonucleotides were designed to amplify the VEGF-X  
sequence from cDNA (figure 3). The ESTs found in  
LifeSeq™ were from a range of tissues, with a slight  
predominance of sequences from ovary, testis,  
20 placenta and lung (Figure 14 and 15). Accordingly  
the oligonucleotides were used to amplify cDNA  
derived from lung and placenta. First-round PCR  
products were found at ~200bp larger than the  
expected sizes, while 3 major species appeared after  
25 a second round of PCR amplification, the smallest of  
which was of the expected size. These fragments were  
cloned and sequenced. The smallest fragment did  
indeed have the sequence originally identified from  
the LifeSeq database, while the others contained  
30 insertions (figure 4).

As the first round of amplification suggested that  
the major species found in cDNA from ovary and  
placenta was not that originally identified in the  
35 LifeSeq™ database, the focus of effort was switched  
to the presumed major species (it seemed likely that

- 30 -

clones 57, 25-27 and 2.1kb clones 1-3 in fig 4 represented the major mRNA species). Conceptual translation of the DNA sequences of these cloned PCR fragments indicated that the complete open reading frame was not present in the clones or in the sequence from LifeSeq™. While all clones contained the same sequence in the region of the translation termination codon, indicating that the end of the open reading frame had been identified, the 5' end of the open reading frame had not been cloned. 5' RACE experiments were therefore carried out in order to find the start of the reading frame. PCR primers designed for RACE experiments are shown in figure 5. RACE PCR products were sequenced directly. Sequence could be obtained from the 3' end of these RACE products but not from the 5' end; probably because the products were not cloned and were therefore heterogeneous at the 5' end. This new sequence was assembled with the existing cloned sequence to give the sequence shown in figure 6. Searching the LifeSeq™ database with this sequence identifies ESTs which extend the sequence a further 140bp in the 5' direction and a further 160bp in the 3' direction (figure 7). This longer contig was used to design oligonucleotide primers to amplify the entire coding sequence (these primer sequences are shown in figure 8). PCR was carried out using primers 5'-1 and vegfX10 (in order to clone a "full-length" cDNA), and with primers 5'-1 and vegfX6 (in order to clone the full coding region, see figure 3 for sequences of vegfX10 and vegfX6). A number of clones were obtained for the shorter fragment, of which clones 4 and 7 contain no PCR errors (sequence of clones 4 & 7 in figure 9). A single clone was obtained for the longer fragment (clone 9), but this sequence appears to contain 2 PCR errors.



The predicted polypeptide from these longer contigs is shown in figure 10. Amino acids 1-22 are predicted to encode a signal sequence (von Heijne, 1986, *Nucleic Acids Res.* 14, 4683-4690). Figure 11 shows an alignment of the protein sequence with VEGFs A-D. The region homologous to the other VEGFs is located towards the C-terminus of the protein. As the VEGF homology domain is expected to belong to the TGF-beta superfamily of growth factors and to consist of a dimer containing both intra- and intermolecular disulphide bonds, initial alignments focussed on the cysteines. However, mapping of the sequence onto the known x-ray structure of the VEGF-A receptor-binding domain (Muller et al (1997) *Proc. Natl. Acad. Sci USA* 94, 7192-7197) suggests that the alignment in figure 11 is plausible, as the extra 4 cysteine residues within the VEGF-homology region of VEGF-X (compared to this region of VEGF-A) correspond to residues which are spatially close in VEGF-A, and may therefore be able to form disulphide bonds.

A search of the PFAM database of protein domains with the full-length polypeptide sequence from figure 10 identifies two domain consensus sequences within the polypeptide. The more C-terminal domain is a "VEGF" domain: (the known VEGFs all contain this domain and the structure of this region of VEGF-A is similar to that of PDGF). Additionally towards the N-terminus of the polypeptide there is a CUB domain (amino acids -40-150). The CUB domain is a 100-110 amino acid extracellular domain found in a number of developmentally-regulated proteins. When the full-length protein is used to search the protein databases using the BLAST 2 algorithm, the scores for matches to CUB domain-containing proteins are more

- 32 -

significant than those to the other VEGFs.

Interestingly, the most significant matches are to the CUB domains of Neuropilins, and Neuropilin-1 was recently identified as a receptor of one of the VEGF-A isoforms VEGF-A<sub>165</sub> (Soker et al. (1998) Cell 92, 735-745).

Assuming that the variant sequences isolated by PCR (i.e. the smaller PCR fragments) use the same translation initiation site as the full-length sequence, they would result in production of the variant proteins shown in figure 12. It may be significant that both of these variant proteins retain the CUB domain and delete all or part of the VEGF-like domain. The production of these variant sequences can be explained by the use of a cryptic splice donor/acceptor site within the VEGF-X sequence (figure 30B, between nt. 998/999): one variant arises by splicing out of the region between nt. 729-998, the other by splicing out of the region between nt. 999-1187.

### Expression

#### 25 Full-length expression constructs

##### Mammalian cells

Clone 4 containing the full CDS of VEGF-X (see figure 9), was used to generate constructs for expression of full-length protein. The sequence was amplified by PCR and cloned into the vector pCDNA6/V5-His so as to add a C-terminal V5 epitope tag and His<sub>6</sub> tag. The DNA and polypeptide sequence in this vector is shown in figure 19. Transient expression in COS cells followed by western blotting and detection via an anti-V5 mAb demonstrates the secretion of a protein of ~50K into the medium in transfected cells only

(figure 22A). This construct can also be used to generate VEGF-X expressing stable CHO cell lines.

#### Baculovirus/Insect-cell expression system

5 For expression in the baculovirus/insect cell system the DNA encoding the predicted mature VEGF-X polypeptide sequence was fused to a sequence encoding a signal derived from melittin, a secreted insect protein. An N-terminal 6His tag was also added to  
10 facilitate purification. The insert was then cloned into the baculovirus expression vector pFASTBAC. The DNA and polypeptide sequence of this construct is shown in figure 20. Infection of *Trichoplusia ni* Hi5 cells with this recombinant baculovirus results in  
15 the secretion of a protein of approximately 45K into the medium (data not shown).

#### E.coli

20 The coding region of VEGF-X has been cloned in a variety of ways for expression as a secreted protein in *E.coli*. A particularly useful expression clone carries an N-terminal fusion to the *E.coli* maltose-binding protein (MBP- derived from the expression vector pMAL-p2, New England Biolabs) and a  
25 C-terminal fusion to a 6His tag. The DNA and polypeptide sequence of this vector is shown in figure 21. Sequential purification of cell fractions on Ni-NTA resin and amylose resin allows the isolation of the expressed protein (see figure 22B).

30

#### Expression of fragments

##### VEGF

35 The VEGF domain of VEGF-X has been expressed in *E.coli*. Similar domains from VEGF-A (Christinger et al. (1996) *PROTEINS: Structure, Function and Genetics* 26, 353-357), and VEGF-D (Achen et al (1998) *Proc.*

- 34 -

Natl. Acad. Sci USA 95, 548-553) have been shown to be capable of binding to the respective receptors. Expression of these domains was carried out using the bacterium *E.coli*. Additionally, the full-length protein was expressed using the baculovirus/insect cell expression system. The oligonucleotide primers which have been obtained for these experiments are shown in figure 13. The construct directed expression in the bacterial cytoplasm, and as expected the protein was produced in insoluble form in inclusion bodies (the DNA and polypeptide sequence used for PDGF domain expression is shown in figure 24). Inclusion bodies were washed, solubilized with urea and the protein purified under denaturing conditions, before refolding by dialysis to remove the urea. Soluble protein was obtained, but shows little evidence of the disulphide bond linked dimers seen with material derived from animal cells (figure 25, compare with figure 22A & B). It is not clear therefore whether this protein is correctly folded.

#### CUB

The CUB domain has been expressed as a soluble secreted protein in *E.coli* (figure 26). The protein was purified by binding to Ni-NTA resin (figure 27) and assayed for activity on HUVECs in an in-vitro proliferation assay.

#### Properties of the VEGF-X protein

The transient mammalian cell expression system described above has been used to generate full-length VEGF-X protein, as shown by antibody detection following Western blotting (see figure 22A).

#### Disulphide bond linked dimers

The other members of the PDGF family of growth

- 35 -

factors, the PDGFs and VEGFs, all exist as dimers in which two monomers constituting the dimer are linked by interchain disulphide bonds. The x-ray structures of PDGF-BB (Oefner et al, 1992), and VEGF-A (Muller et al, 1997) are known and indicate that at least these two members of the family contain two interchain disulphide bonds. Practically this means that in SDS-PAGE analysis of these growth factors the presence of interchain disulphide bonds is shown by a large decrease in mobility in the absence of reducing agent (ie. the nonreduced dimer migrates more slowly through the gel than the reduced monomer). This effect was also expected for VEGF-X, and has been demonstrated for the material obtained from transient mammalian cell expression (figure 22A). In the case of the full length material produced in *E.coli* only some 10% of the total VEGF-X protein appears to be present as disulphide bond-linked dimers (figure 22B). However, these results provide evidence that the mammalian cell-derived protein is correctly folded, and that a portion of the *E.coli*-derived protein is too.

#### Glycosylation

There are 3 predicted potential N-linked glycosylation sites within the VEGF-X protein: at residues 25, 55 and 254 of the polypeptide sequence. The predicted molecular mass of the mature VEGF-X protein is 40kDa, but SDS-PAGE and western blotting (detection via an introduced C-terminal epitope tag-see figure 19) of the full-length protein expressed in COS cells gives a band slightly larger than the expected size (45-50kDa) as well as one at 25kDa (figure 22A). This smaller band is presumed to be a C-terminal proteolysis fragment derived from the full-length molecule (controls from uninfected cells do not show this band), probably corresponding to a

- 36 -

cleavage between the CUB and VEGF domains. EndoH treatment of the preparation gives a slight mobility change for the full-length protein (figure 23), but for the smaller VEGF domain fragment there is a clear change, indicating that the predicted glycosylation site within the VEGF domain at residue 254 is indeed glycosylated.

#### Activity of proteins in cell-based assays

Protein samples were tested for activity in cell proliferation, cell migration and *in-vitro* angiogenesis assays. Active samples can also be tested in the *in vivo* matrigel mouse model of angiogenesis.

#### Full-length VEGF-X protein

Conditioned medium derived from COS cells transiently expressing VEGF-X (see figure 22A) displayed no detectable activity in any of the assays. However, as VEGF-X protein could only be detected in this preparation by Western blotting, and not by Coomassie-staining of gels, it is clearly present at very low levels and this may be the reason for the observed lack of activity in the cell proliferation, migration or *in vitro* angiogenesis tests.

#### VEGF domain

The VEGF domain protein described above has been tested in cell proliferation (on a range of cell types), cell migration and *in vitro* angiogenesis assays and has failed to show activity in any of these tests. As suggested above, this may be due to incorrect folding of this protein.

#### CUB domain

The CUB domain protein at the highest dose tested

- 37 -

(1µg/ml) appears to inhibit proliferation of HUVECs in the absence of other stimulation (figure 28A & B). This effect is also seen following stimulation with the lowest VEGF-A<sub>165</sub> dose tested (1ng/ml- figure 28C).  
5 The CUB domain of VEGF-X therefore appears to show antiproliferative activity on HUVECs, even in the presence of low VEGF-A<sub>165</sub> doses.

#### Tissue distribution of mRNA

10 VEGF-A mRNA expression has been shown to be upregulated in a wide variety of human tumors (lung, breast, ovarian, colon, stomach, liver, pancreas, kidney, bladder and prostate- Takahashi et al, 1995). Tumor VEGF-A expression has been shown to correlate  
15 with tumor growth rate, microvascular density and tumor metastasis (Takahashi et al, 1995). It was thus of interest to examine the mRNA expression patterns of VEGF-X. Accordingly, Northern blot analysis of mRNA derived from different tissues has  
20 been carried out. The results indicate that although the VEGF-X mRNA is expressed at low levels, it is present in a wide range of tissues. PCR amplification of cDNA from a range of tissue sources supports this idea (figure 29A). The major mRNA  
25 species is approximately 3.1kb in size. There is no significant upregulation seen in tumour cell lines or in tumour tissues tested (figure 29B), with the possible exception of the cell lines GI-117 (lung carcinoma) and SaOS-2 (osteosarcoma). The results of  
30 these initial tissue distribution studies do not, therefore, provide evidence for upregulation of VEGF-X in tumour growth, as is seen with VEGF-A.

#### Genomic structure of the VEGF-X gene

35 A genomic BAC clone covering the 3' part of the VEGF-X locus was isolated by hybridisation screening

- 38 -

of nylon filters containing a human BAC library. Direct sequencing of this clone using oligonucleotide primers based on the VEGF-X cDNA sequence allowed the determination of several intron/exon boundaries (figure 30). Interestingly, the position of the mRNA splice site within the PDGF domain (nt 1187/1188 in figure 30B) is conserved with respect to those in the VEGF-A and VEGF-D genes (Tischer et al, 1991; Rocchigiani et al, 1998).

#### Materials & Methods

PCR, Cloning, DNA sequence determination and BAC screening.

All primers were purchased from Eurogentec, Seraing, Belgium. Insert-specific sequencing primers (15- and 16-mers) were designed by visual inspection of the DNA sequences. DNA was prepared on Qiagen-tip-20 columns or on Qiaquick spin columns (Qiagen GmbH, Düsseldorf, Germany) and recovered from the spin columns in 30µl Tris/EDTA-buffer (10mM TrisHCl pH 7.5, 1 mM EDTA (sodium salt)). Sequencing reactions were performed using BigDye™ Terminator Cycle Sequencing Ready Reaction kits (Perkin Elmer, ABI Division, Foster City, CA, USA) and were run on an Applied Biosystems 377 DNA sequencer (Perkin Elmer, ABI Division, Foster City, CA, USA). Polymerase chain reactions were carried out according to standard procedures (Ausubel et al, 1997). The PCR fragments were cloned into vectors pCR2.1 (Invitrogen, Carlsbad, CA, USA) or pCR-TOPO (Invitrogen, NL) according to the manufacturer's instructions. One of those vectors, plasmid VEGFX/pCR2.1 1TOPO FL was deposited on 1 March 1999 under Accession No. LMBP 3925. After sequence determination, the inserts were cloned into the desired expression vectors (see



- 39 -

figures 19, 20, 21, 24 & 26).

5 A human genomic BAC library (Genome Systems, Inc., St  
Louis, MI, USA) was screened by hybridisation to  
oligonucleotides derived from the VEGF-X cDNA  
sequence, according to the manufacturer's  
instructions. BAC DNA was prepared using a Qiagen  
plasmid midi kit (Qiagen GmbH, Düsseldorf, Germany )  
10 according to the manufacturer's instructions with  
some modifications (after clearing of the lysate from  
chromosomal DNA, supernatants from individual  
preparations were pooled on a single column (tip  
100), and after the 70 % EtOH wash, the pellet was  
resuspended overnight at 4°C in 100 µl TE). 20-mer  
15 sequencing primers were designed based on the known  
cDNA sequence, and sequencing carried out as above.

#### 5' RACE

20 In order to extend the cDNA clone in a 5' direction  
RACE reactions were carried out. Since it was known  
that the mRNA is present in placenta and skeletal  
muscle, Marathon-Ready™ placenta and skeletal muscle  
cDNAs were purchased from Clontech (Palo Alto CA.  
25 USA) and used according to the manufacturer's  
instructions. DNA fragments were excised from  
agarose gels, purified using QiaQuick PCR  
purification columns (Qiagen GmbH, Düsseldorf,  
Germany) and sequenced directly.

30

#### VEGF-X protein expression and purification

DNA fragments encoding the desired protein sequences  
were amplified by PCR and cloned into appropriate  
expression vector systems.

35

For mammalian cell expression, the full coding

- 40 -

sequence was cloned into the vector pcDNA6/V5-his (Invitrogen Leek, NL, see figure 19 for construct sequence), so as to add a C-terminal peptide tag to assist in detection and purification.

5

For insect cell expression the sequence of the predicted mature polypeptide was initially amplified to add an N-terminal 6His peptide and then cloned into the pMelBacB vector (Invitrogen, Leek, NL) to add an insect cell signal sequence. The entire insert was then PCR-cloned into the vector pFASTBAC-1 (LifeTechnologies, Gaithersburg, MA, USA) for construction of a baculovirus according to the manufacturer's instructions.

15

For *E.coli* expression, the coding region was PCR amplified to add a C-terminal 6His tag and then cloned into the vector pMAL-p2 (New England Biolabs, Beverly, MA, USA). The coding sequence of this construct is shown in figure 21). The protein was purified first on Ni-NTA resin (Qiagen GmbH, Düsseldorf, Germany) and then on amylose resin (New England Biolabs, Beverly, MA, USA), according to the manufacturers' instructions.

25

DNA sequences encoding the CUB and VEGF domain fragments of VEGF-X were PCR amplified and cloned into pET22b and pET21a (Novagen, Madison, WI, USA) respectively. The CUB domain protein was prepared either from the periplasm or medium of induced cultures by standard methods (Ausubel et al, 1997). The protein was initially purified by precipitation with 20% ammonium sulphate. After overnight dialysis vs 20mM Tris HCl pH7.5, 100mM NaCl to remove ammonium sulphate, the protein was further purified on Ni-NTA resin as described above. The VEGF domain protein was expressed in insoluble form, and preparation of

35

inclusion bodies was carried out using standard procedures (Ausubel et al 1997). Inclusion bodies were dissolved in 6M guanidine hydrochloride, 20mM Tris Hcl pH8.0, 200mM NaCl, 1mM 2-mercaptoethanol, and purified on Ni-NTA resin (Qiagen GmbH, Düsseldorf, Germany) according to the manufacturer's instructions. The protein was refolded by dialysis against several changes of buffer containing decreasing concentrations of denaturant.

Analysis of protein glycosylation was carried out using EndoH (Roche Molecular Biochemicals, Brussels, BE) according to the manufacturer's instructions.

#### Cell Proliferation Assay

Human umbilical vein endothelial cells (HUVECs) (Clonetics, San Diego, CA.) were trypsinized with 0.05% trypsin/0.53mM EDTA (Gibco, Gaithersburg, MD.), resuspended in the EGM-2 (Clonetics, San Diego, CA.), counted, and distributed in a 96-well tissue culture plate at 5,000 cells/well. Following cell attachment and monolayer formation (16 hours), cells were stimulated with various concentrations of truncated VEGF-X (CUB domain or VEGF domain) or dilutions of culture supernatants of the full-length VEGF-X (COS 7 or HEK293) in DMEM (Gibco, Gaithersburg, MD.) containing 0.5% to 2% FBS (HyClone, Logan, UT) as indicated. For human fetal dermal fibroblasts (American Type Culture Collection, Rockville, MD.), the growth medium was replaced by DMEM containing 0.1% BSA (Sigma, St. Louise, MO.) with or without various concentrations of truncated VEGF-X proteins. For HCASMC (Clonetics, San Diego, CA.), the medium was replaced by DMEM containing 0.5% FBS. The cells were treated for a further 24 hr-72 hr. For the measurement of proliferation, the culture media were replaced with 100 µl of DMEM containing 5% FBS and 3

- 42 -

5         $\mu$ Ci/ml of [3H]-thymidine (Amersham, Arlington Heights, IL.). Following pulse labeling, cells were fixed with methanol/acetic acid (3:1, vol/vol) for 1 hour at room temperature. The cells were washed  
10       twice with 250  $\mu$ l/well of 80% methanol. The cells were solubilized in 0.05% trypsin (100 $\mu$ l/well) for 30 minutes then in 0.5% SDS (100  $\mu$ l/well) for another 30 minutes. Aliquots of cell lysates (180  $\mu$ l) were combined with 2 ml of scintillation cocktail (Fisher, Springfield, NJ) and the radioactivity of cell  
15       lysates was measured using a liquid scintillation counter (Wallac 1409). In each case, samples were performed in quadruplicate.

#### 15       Chemotaxis Assay

20       The chemotactic response of HUVECs was assayed using a 48-well modified Boyden chamber (NeuroProbe, Cabin John, MD.) and collagen-coated (0.1mg/ml type I collagen, Collaborative Biomedical, Bedford, MA.) polycarbonate membrane filters with a pore diameter of 8  $\mu$ m (NeuroProbe, Cabin John, MD.). Cell  
25       suspensions (15,000/well) were loaded to the upper part of the chemotaxis chamber and stimulated for 4 hours with rhVEGF<sub>165</sub> (0.1-10 ng/ml) (Calbiochem, San Diego, CA.) or various concentrations of truncated VEGF-X (PDGF domain). Cells remaining on the top of the membrane were removed. Migration was assessed by counting the number of cells that migrated to the  
30       lower side of the filter membrane. The membrane was fixed with 10% formaldehyde for 15 min, followed by staining with Gill's hematoxylin III (Poly Scientific, Bay Shore, NY.). The assay was performed in triplicates and six independent high power fields per well were counted using a light microscope at 250  
35       magnification. The results were expressed as the fold of unstimulated cells (EGM containing 0.1% BSA).

### **In Vitro Angiogenesis Assay**

*In vitro* angiogenesis in fibrin gels was quantitated using spheroids of human umbilical vein endothelial cells (Korff et al., 1998). To generate endothelial cell spheroids of defined size and cell number, a specific number of cells (~ 800 cells per spheroid) was suspended in EGM-2 culture medium containing 20% methylcellulose (Sigma, St. Louis, MO.), seeded into nonadherent round-bottom 96-well plates. All suspended cells in one well contributed to the formation of a single endothelial cell spheroid within 24 hours. A fibrin gel stock solution was prepared freshly prior to use by mixing 3mg/ml fibrinogen (Calbiochem, San Diego, CA.) in Medium 199 (Gibco, Gaithersburg, MD.). Assays were performed in 24-well culture plates. The 1ml fibrinogen stock was mixed with 50 HUVEC spheroids and the corresponding test substance including rh-VEGF<sub>165</sub> or various concentration of VEGF-X. The spheroid-containing fibrinogen was rapidly transferred into 24-well plates. Fifteen microliters of thrombin (100 NIH U/ml stock, Sigma, St. Louis, MO.) was added to the gel for the fibrin gel formation. The gel formation usually occurred within 30 seconds. After gel formation, 1ml/well of Medium 199 supplemented with 20% FBS, 1mg/ml  $\epsilon$ -aminocaproic acid (Calbiochem, San Diego, CA.) and antibiotics were added. The gel was incubated at 37°C (5%CO<sub>2</sub>, 95% air, 100% humidity). After 3 days, *in vitro* angiogenesis was quantitated by measuring the length of the three longest capillary sprouts that had grown out of each spheroid (100X magnification), analyzing at least 10 spheroids per experimental group and experiment.

### **Matrigel Mouse Assay**

The matrigel mouse assay is carried out as described by Passanti et al (1992).

Analysis of VEGF-X gene expression by RT-PCR analysis.

5  
10  
15  
20  
25  
30  
35

Oligonucleotide primers VEGF-E2 and VEGF-X14 (figure 16; figure 5) were used for the specific PCR amplification of a 350 bp fragment from VEGF-X. PCR amplifications were performed on human multiple tissue cDNA (MTC™) panels (Clontech human MTC panels I and II and human Tumor MTC panel) normalised to the mRNA expression levels of six different housekeeping genes. In addition, cDNA was made from different tumor cell cultures (Caco-2 colorectal adenocarcinoma; T-84 colorectal carcinoma; MCF-7 breast adenocarcinoma; T-47D breast ductal gland carcinoma; HT1080 bone fibrosarcoma; SaOS-2 osteosarcoma; SK-N-MC neuroblastoma; HepG2 hepatoblastoma; JURKAT T-cell leukemia and THP-1 myelomonocytic leukemia). For the preparation of tumor cell cDNA, cells were homogenised and total RNA prepared using the RNeasy Mini kit (Qiagen GmbH, Hilden, Germany) according to manufacturer's instructions. 1 µg of total RNA was reverse transcribed using oligo(dT)15 as a primer and 50 U of Expand™ Reverse Transcriptase (Boehringer Mannheim, Mannheim, Germany) according to the manufacturer's instructions. PCR reactions with VEGF-X-specific or glyceraldehyde-3-phosphate dehydrogenase (G3PDH)-specific primers were then performed on 1 µl of this cDNA. For all cDNAs, PCR reactions with VEGF-X specific primers were performed in a total volume of 50 µl, containing 5 µl (± 1 ng) of cDNA, 1x Advantage KlenTaq PCR reaction buffer, 0.2 mM dNTP, 250 nM of primers VEGF-E2 and VEGF-X14 and 1 µl of Advantage KlenTaq polymerase mix. Samples were heated

- 45 -

to 95°C for 30 s and cycling was done for 30 s at 95°C and 30 s at 68°C for 25, 30 or 35 cycles. Control reactions using specific primers that amplify a 1 kb fragment of the housekeeping gene G3PDH were also performed according to the manufacturer's instructions.

#### Northern blot analysis of VEGF-X.

Northern blots containing 2 µg of poly(A)-rich RNA derived from different human tissues (Clontech Laboratories; MTN™ blot, MTN™ blot II and Cancer Cell Line MTN™ blot) were hybridized according to the manufacturers instructions with a α-[<sup>32</sup>P]-dCTP random-priming labelled (Multiprime labelling kit, Roche Diagnostics) 293 bp specific VEGF-X fragment (PinAI-StuI fragment including 92 bp of the 3' end coding region and 201 bp of the 3' untranslated region of VEGF-X). The blots were hybridized overnight at 68°C and final washes at high stringency were at 68°C in 0.1x SSC/0.1 % SDS. The membranes were autoradiographed for 1 to 3 days with intensifying screens.

#### Full length VEGF-X

The effect of full length VEGF-X on proliferation of HuVEC cells was determined by the <sup>3</sup>H-Thymidine incorporation assay. HuVEC cells were serum starved for 24 hours prior to treatment with the full length VEGF-X at the concentration range from 100 pg/ml-10 µg/ml. There was no effect of VEGF-X at 100 pg/ml-10 ng/ml on endothelial cell proliferation. At the higher concentrations of FL-VEGF-X (100 ng/ml and 1 µg/ml) there was a marked inhibition of endothelial cell proliferation. This is probably due to the very high endotoxin level in the samples. The VEGF-X sample was purified in order to decrease the

endotoxin level and is currently tested in the cell proliferation assay.

#### The Summary from Testing the CUB Domain

5 The effect of CUB domain on inhibition of HuVEC proliferation either serum- (2%), rh-VEGF or bFGF-stimulated, was assessed by the <sup>3</sup>H-Thymidine incorporation assay. Cells were serum starved followed by the treatment with the CUB domain and  
10 various growth factors. Results showed that the CUB domain inhibited endothelial cell proliferation, either serum- (2%), rh-VEGF or bFGF-stimulated in a dose dependent manner with maximal inhibition at 10 µg/ml. There was approximately a 2-fold inhibition  
15 of proliferation (at 10 µg/ml) of cells stimulated with VEGF and bFGF and nearly a 5-fold inhibition of cells stimulated with serum (2%). Results with the LDH assay showed that there was no cytotoxicity associated with the inhibition of cell proliferation  
20 by the CUB domain.

Therefore, the N-terminus of the polypeptide from Figure 10 has been shown to possess a CUB domain. When database searches are carried out using the  
25 full-length coding sequence the best matches (i.e. for a BLAST search, those with the lowest probability score) are found with the CUB domain rather than with the VEGF-like domain. The best match from searching release 37 of the SWISSPROT database (Feb 1999) is to  
30 the CUB domain of a neuropilin from *Xenopus laevis*, and the matches to the CUB domains of human neuropilins 1 and 2 are also more significant than matches to the VEGFs.

35 This similarity is provocative, given the identification of neuropilin-1 and -2 as cellular receptors for the VEGF-A 165 (Stoker et al. 1998,



reviewed in Neufeld et al. 1999). It is plausible  
therefore that VEGF-X could exert dual regulatory  
effects: via interaction with the tyrosine kinase  
VEGF-receptors mediated by the VEGF-like domain, as  
5 well as via interaction with VEGF isoforms or with  
the neuropilin receptors, mediated by the CUB  
domain.

To the best of our understanding the latter would be  
10 entirely novel, and searches on the most recent  
release of the Incyte database do not reveal any  
other proteins containing both CUB and VEGF-like  
domains. This arrangement of domains suggests  
possible positive or negative models of regulation:

15 *Positive-* the VEGF-like domain is able to interact  
productively with the tyrosine kinase VEGF receptors  
giving activation, and the CUB domain is able to  
interact productively with the neuropilin receptor  
20 giving activation.

*Negative-* the VEGF-like domain does not interact  
productively with the tyrosine kinase VEGF receptors,  
either preventing receptor dimerisation or blocking  
25 the VEGF binding sites. Further, the CUB domain does  
not interact productively with the neuropilin  
receptors, either preventing receptor activation or  
blocking the VEGF binding sites, or indeed by binding  
to VEGF isoforms and preventing their interaction  
30 with receptors.

TABLE 1

	<u>ORIGINAL RESIDUE</u>	<u>EXEMPLARY SUBSTITUTIONS</u>
	ALA	SER, THR
5	ARG	LYS
	ASN	HIS, SER
	ASP	GLU, ASN
	CYS	SER
	GLN	ASN, HIS
10	GLU	ASP, GLU
	GLY	ALA, SER
	HIS	ASN, GLN
	ILE	LEU, VAL, THR
	LEU	ILE, VAL
15	LYS	ARG, GLN, GLU, THR
	MET	LEU, ILE, VAL
	PHE	LEU, TYR
	SER	THR, ALA, ASN
	THR	SER, ALA
20	TRP	ARG, SER
	TYR	PHE
	VAL	ILE, LEU ALA
	PRO	ALA

## References

1. Ausubel, FM, R Brent, RE Kingston, DD Moore, JG  
Seidman, JA Smith, K Struhl (Eds). (1997)  
5 *Current Protocols in Molecular Biology*, John  
Wiley and Sons.
2. von Heijne, G. (1986) *Nucleic Acids Res.* 14,  
4683-4690.  
10
3. Muller, YA, B Li, HW Christinger, JA Wells, BC  
Cunningham and AM de Vos. (1997) Vascular  
endothelial growth factor: crystal structure and  
functional mapping of the kinase domain receptor  
15 binding site. *Proc. Natl. Acad. Sci USA* 94,  
7192-7197.
4. Korff, T and Augustic, H.G. (1998) Integration  
of endothelial cells in multicellular spheroids  
prevents apoptosis and induced differentiation.  
20 *The Journal of Cell Biology.* 143, 1341-1352
5. Christinger, HW, YA Muller, LT Berleau, BA Keyt,  
BC Cunningham, N Ferrara and AM de Vos. (1996)  
25 *PROTEINS: Structure, Function and Genetics* 26,  
353-357.
6. Achen, MG, M Jeltsch, E Kukk, T Makinen, A  
Vitali, AF Wilks, K Alitalo and SA Stacker.  
30 (1998) *Proc. Natl. Acad. Sci USA* 95, 548-553.
7. Siemeister, G, B Schnurr, K Mohrs, C Schachtele,  
C Marne and G Martiny-Baron. (1996) *Biochem.*  
*Biophys. Res. Commun.* 222, 249-255.  
35
8. Soker, S, S Takashima, HQ Miao, G Neufeld and M

Klagsbrun (1998). Neuropilin-1 is expressed by endothelial and tumor cells as an isoform-specific receptor for vascular endothelial growth factor, *Cell* 92: 735-745.

5

9. Neufeld, G, T Cohen, S Gengrinovitch and Z Poltorak (1999). Vascular endothelial growth factor and its receptors, *FASEB J.* 13:9-22.

10

10. Oefner, C., D'Arcy, A., Winkler, F.K., Eggimann, B. and Hosang, M. (1992). Crystal structure of human platelet-derived growth factor BB. *EMBO J.* 11, 3921-3926.

15

11. Passanti, A., Taylor, R.M., Pili, R., Guo, Y., Long, P.V., Haney, J.A., Pauly, R., Grant, D.S. and Martin, G.R. (1992) A simple, quantitative method for assessing angiogenesis and antiangiogenic agents using reconstituted basement membrane, heparin and fibroblast growth factor. *Laboratory Investigation*, 67, 519-528.

20

- 25 12. Rocchigiani, M., Lestingi, M., Luddi, A., Orlandini, M., Franco, B., Rossi, E., Ballabio, A., Zuffardi, O. and Oliviero, S. (1990). Human FIGF: cloning, gene structure, and mapping to chromosome Xp22.1 between the PIGA and the GRPR genes. *Genomics*, 47, 207-216.

30

13. Takahashi, Y., Kitadai, Y., Bucana, C.D., Cleary, K.R. and Ellis, L.M. (1995). Expression of vascular endothelial growth factor and its receptor, KDR, correlates with vascularity, metastasis and proliferation of human colon

35

cancer. *Cancer Research*, 55: 3964-3968.

14. Tischler, E., Mitchell, R., Hartman, T., Silva, M., Gospodarowicz, D., Fiddes, J.C. and Abraham, J.A. (1991). The human gene for vascular endothelial growth factor: Multiple protein forms are encoded through alternative exon splicing. *J. Biol. Chem.* 266, 11947-11954.

SEQUENCE LISTING

- 5      Sequence ID No 1      corresponds to the amino acid  
sequence from position 23 to 345  
of the amino acid sequence  
illustrated in Figure 10.
- 10      Sequence ID No 2      is the amino acid sequence  
illustrated in Figure 10.
- 15      Sequence ID No 3      corresponds to the sequence from  
position 257 to 1291 of the  
nucleotide sequence illustrated  
in Figure 9.
- 20      Sequence ID No 4      corresponds to the polynucleotide  
sequence of VEGFX1 illustrated in  
Figure 3.
- 25      Sequence ID No 5      corresponds to the polynucleotide  
sequence of VEGFX2 illustrated in  
Figure 3.
- 30      Sequence ID No 6      corresponds to the polynucleotide  
sequence of VEGFX3 illustrated in  
Figure 3.
- 35      Sequence ID No 7      corresponds to the polynucleotide  
sequence of VEGFX4 illustrated in  
Figure 3.
- Sequence ID No 8      corresponds to the polynucleotide  
sequence of VEGFX5 illustrated in  
Figure 3.
- Sequence ID No 9      corresponds to the polynucleotide  
sequence of VEGFX6 illustrated in

## Figure 3.

5	Sequence ID No 10	corresponds to the polynucleotide sequence of VEGFX7 illustrated in Figure 3.
10	Sequence ID No 11	corresponds to the polynucleotide sequence of VEGFX8 illustrated in Figure 3.
	Sequence ID No 12	corresponds to the polynucleotide sequence of VEGFX9 illustrated in Figure 3.
15	Sequence ID No 13	corresponds to the polynucleotide sequence of VEGFX10 illustrated in Figure 3.
20	Sequence ID No 14	corresponds to the polynucleotide sequence of VEGFX11 illustrated in Figure 4.
25	Sequence ID No 15	corresponds to the polynucleotide sequence of VEGFX12 illustrated in Figure 4.
30	Sequence ID No 16	corresponds to the polynucleotide sequence of VEGFX13 illustrated in Figure 4.
	Sequence ID No 17	corresponds to the polynucleotide sequence of VEGFX14 illustrated in Figure 4.
35	Sequence ID No 18	corresponds to the polynucleotide sequence 5'-1 in Figure 8.

- Sequence ID No 19 corresponds to the polynucleotide sequence 5'-2 in Figure 8.
- 5 Sequence ID No 20 corresponds to the polynucleotide sequence of VEGFX6 illustrated in Figure 13.
- 10 Sequence ID No 21 corresponds to the polynucleotide sequence of VEGFX7 illustrated in Figure 13.
- 15 Sequence ID No 22 corresponds to the polynucleotide sequence of VEGFX8 illustrated in Figure 13.
- 20 Sequence ID No 23 corresponds to the polynucleotide sequence of VEGFX9 illustrated in Figure 13.
- 25 Sequence ID No 24 corresponds to the polynucleotide sequence of VEGBAC1 illustrated in Figure 13.
- 30 Sequence ID No 25 corresponds to the polynucleotide sequence of VEGBAC2 illustrated in Figure 13.
- 35 Sequence ID No 26 corresponds to a polypeptide having the amino acid sequence from amino acid position 40 to 150 of the sequence of Figure 10.
- Sequence ID No 27 corresponds to a polypeptide having the amino acid sequence illustrated in Figure 26.
- Sequence ID No 28 corresponds to the sequence from



position 5 to 508 of the  
nucleotide sequence illustrated  
in Figure 26.

5      Sequence ID No 29      corresponds to the nucleotide  
sequence from position 5 to 508  
of the nucleotide sequence  
illustrated in Figure 26.

10     Sequence ID No 30      corresponds to the sequence from  
position 214 to 345 of the  
nucleotide sequence illustrated  
in Figure 10.

CLAIMS

1. A nucleic acid molecule encoding a VEGF-X protein or a functional equivalent, derivative or bioprecursor thereof, said protein comprising any of the sequences from position 23 to 345 of the amino acid sequence illustrated in Figure 10, or the complete sequence as illustrated in Figure 10.
2. A nucleic acid molecule according to claim 1 wherein said nucleic acid is a DNA molecule.
3. A nucleic acid molecule according to claim 1 or 2 wherein said nucleic acid is a cDNA molecule.
4. A nucleic acid molecule according to claim 3 comprising the nucleotide sequence from position 257 to 1291 of the nucleotide sequence illustrated in Figure 9, or sequences that hybridise thereto under high stringency conditions or the complement thereto.
5. An antisense molecule capable of hybridising to a molecule according to any of claims 1 to 4 under high stringency conditions.
6. A nucleic acid molecule according to any of claims 1 to 4 which is of mammalian origin.
7. A nucleic acid molecule according to claim 6 which is of human origin.
8. An isolated VEGF-X protein, or a functional equivalent, derivative or bioprecursor thereof, having an amino acid sequence from position 23 to 345 of the amino acid sequence illustrated in Figure 10 or the complete amino acid sequence of Figure 10.

9. A VEGF-X protein, or a functional equivalent, derivative or bioprecursor thereof, encoded by a nucleic acid molecule as defined in any of claims 1 to 4.
- 5
10. A protein according to claim 9, which comprises the amino acid sequence illustrated in Figure 10.
- 10
11. An expression vector comprising a nucleic acid molecule according to any of claims 1 to 4.
- 15
12. An expression vector according to claim 11 further comprising a nucleotide sequence encoding a reporter molecule.
- 15
13. An expression vector comprising an antisense molecule according to claim 5.
- 20
14. A nucleic acid molecule according to any of claims 1 to 4 or an antisense molecule according to claim 5 for use as a medicament.
- 25
15. A host cell transformed or transfected with an expression vector according to claim 11 or 12.
- 25
16. A host cell transformed or transfected with an expression vector according to claim 13.
- 30
17. A transgenic cell, tissue or organism comprising a transgene capable of expressing a VEGF-X protein according to claim 8 or 9.
- 35
18. A transgenic cell, tissue or organism according to claim 17, wherein said transgene is included in an expression vector.
19. A VEGF-X protein or a functional equivalent,

- 58 -

derivative or bioprecursor thereof, expressed by a cell according to claim 15.

5 20. A VEGF-X protein, or a functional equivalent, derivative or bioprecursor thereof, expressed by a transgenic cell, tissue or organism according to claim 17.

10 21. A process for producing a VEGF-X protein according to any of claims 8 to 10, said process comprising transforming a host cell or organism with an expression vector according to claim 11, and recovering the expressed protein from said host cell or organism.

15 22. An antibody capable of binding to a protein according to any of claims 8 to 10, or an epitope thereof.

20 23. An antibody according to claim 22 for use as a medicament.

25 24. A pharmaceutical composition comprising an antibody according to claim 22 together with a pharmaceutically acceptable carrier diluent or excipient thereof.

30 25. A method of identifying VEGF-X protein in a sample which method comprises contacting said sample with an antibody according to claim 22 and monitoring for binding of any protein to said antibody.

35 26. A kit for identifying the presence of VEGF-X protein in a sample which comprises an antibody according to claim 22 and means for contacting said antibody with said sample.

- 59 -

27. A method of identifying compounds which modulate angiogenesis which method comprises providing a host cell or organism according to claim 15 or a transgenic cell, tissue or organism according to claim 17, contacting a test compound with said cell, tissue or organism and monitoring for an effect of said compound on said VEGF compared to a host cell or organism according to claim 15 or a transgenic cell tissue or organism according to claim 17 which has not been contacted with said compound.

28. A compound identifiable according to the method of claim 27.

29. A compound according to claim 28 for use as a medicament.

30. A nucleic acid sequence comprising the nucleotide sequences illustrated in any of Figures 3, 5, 8 or 13.

31. A method for producing a polypeptide, said method comprising the steps of:

- a) culturing the host cell of claim 15 under conditions suitable for expression of the polypeptide; and
- b) recovering the polypeptide from the host cell culture.

32. A method of inhibiting angiogenic activity and inappropriate vascularisation including formation and proliferation of new blood vessels, growth and development of tissues, tissue regeneration and organ and tissue repair in a subject said method comprising administering to said subject an amount of an antisense molecule according to claim 5 in sufficient

- 60 -

concentration to reduce or prevent said angiogenic activity.

5 33. A method of inhibiting angiogenic activity or inappropriate vascularisation including any of formation and proliferation of new blood vessels, growth and development of tissues, tissue  
10 regeneration and organ and tissue repair in a subject said method comprising administering to said subject an amount of an antibody according to claim 22 in  
sufficient concentration to reduce or prevent said angiogenic activity or inappropriate vascularisation.

15 34. A method of inhibiting angiogenic activity or inappropriate vascularisation including any of formation and proliferation of new blood vessels, growth and development of tissues, tissue  
20 regeneration and organ and tissue repair in a subject, said method comprising implanting in said subject cells that express an antibody according to claim 22.

25 35. A method of treating or preventing any of cancer, rheumatoid arthritis, psoriasis and diabetic retinopathy, said method comprising administering to said subject an amount of an antisense molecule according to claim 5 in sufficient concentration to  
treat or prevent said disorders.

30 36. A method of treating or preventing any of cancer, rheumatoid arthritis, psoriasis and diabetic retinopathy, said method comprising administering to said subject an amount of an antibody according to  
35 claim 22 in sufficient concentration to reduce or prevent said disorders.

37. A method of promoting angiogenic activity or

- vascularisation to promote wound healing, skin graft growth, tissue repair, proliferation of new blood vessels, tissue regeneration and organ repair which method comprises applying or delivering to a site of interest a therapeutically effective amount of any of a group selected from a protein according to claim 8 and a nucleic acid molecule encoding a VEGF-X protein or a functional equivalent, derivative or bioprecursor thereof comprising an amino acid sequence illustrated in Figure 10, an expression vector comprising said nucleic acid molecule and a pharmaceutical composition comprising any of said nucleic acid molecule and said protein.
38. A method of treating wounds selected from the group consisting of dermal ulcers, pressure sores, venous sores, diabetic ulcers and burns by applying to said wound a therapeutically effective amount of any of a VEGF-X protein according to claim 8, a pharmaceutical composition comprising said protein and a pharmaceutically acceptable carrier, diluent or excipient therefor.
39. A nucleic acid molecule encoding a polypeptide having a CUB domain said polypeptide comprising the amino acid sequence from position 40 to 150 of the sequence of Figure 10.
40. A nucleic acid molecule encoding a polypeptide having a CUB domain, said polypeptide comprising the amino acid sequence of Figure 26.
41. A nucleic acid molecule according to claim 39 or 40, comprising the nucleotide sequence from position 5 to 508 of the sequence illustrated in Figure 26.
42. A nucleic acid molecule according to any of

- 62 -

claims 39 to 41 comprising the nucleotide sequence illustrated in Figure 26.

- 5       43. A nucleic acid molecule encoding a VEGF like domain comprising the sequence from position 214-345 of the sequence of Figure 10 or the sequence from position 15 to 461 illustrated in Figure 24.
- 10       44. An expression vector comprising a nucleic acid molecule according to any of claims 39 to 42.
45. An expression vector comprising a nucleic acid molecule according to claim 43.
- 15       46. A host cell transformed or transfected with an expression vector according to claim 44.
47. A host cell transformed or transfected with an expression vector according to claim 45.
- 20       48. A protein expressed by the cell according to claim 46.
49. A protein expressed by the cell according to claim 47.
- 25       50. A method of identifying compounds that inhibit or enhance angiogenic activity, said method comprising contacting a cell expressing a VEGF receptor and/or a neuropilin 1 or 2 type receptor
- 30       with said compound in the presence of a VEGF-X protein according to claim 8 and monitoring for the effect of said compound or said cell when compared to a cell which has not been contacted with said
- 35       compound.
51. A compound identifiable according to the method



of claim 50 as an inhibitor or enhancer of angiogenic activity.

5 52. A method of inhibiting angiogenic activity or inappropriate vascularisation, said method comprising contacting a cell expressing a VEGF receptor and a neuropilin type receptor with a protein selected from any of a protein according to any of claims 8 to 10 and a protein according to claim 48 or a protein  
10 according to claim 49.

15 53. Use of a nucleotide sequence illustrated in any of Figures 14 and 15 in identifying a VEGF-X protein according to claim 8.

20 54. A nucleic acid molecule encoding a polypeptide comprising a CUB domain having the sequence from position 40 to 150 of the sequence of Figure 10 or from position 5 to 508 of the sequence of Figure 26 and a sequence encoding a VEGF domain.

25 55. A nucleic acid molecule according to claim 54 wherein said sequence encoding said VEGF domain is selected from the sequences encoding any of VEGF A to D or isoforms or variants thereof.

30 56. A nucleic acid molecule encoding a polypeptide comprising the amino acid sequence from position 40 to 150 of the sequence illustrated in Figure 10 for use as a medicament.

35 57. Use of a nucleic acid molecule encoding a polypeptide having the amino acid sequence from position 40 to 150 of the sequence illustrated in Figure 10 in the manufacture of a medicament for treatment of disease conditions associated with inappropriate angiogenesis such as tumour or cancer

- 64 -

growth, retinopathy, osteoarthritis or psoriasis.

58. A polypeptide comprising the amino acid sequence  
from position 40 to 150 of the sequence illustrated  
5 in figure 10 for use as a medicament.

59. A polypeptide comprising the amino acid sequence  
from position 40 to 150 of the sequence illustrated  
in Figure 10 in the manufacture of a medicament for  
10 the treatment of disease conditions associated with  
inappropriate angiogenesis such as tumour growth,  
retinopathy, osteoarthritis or psoriasis.

60. Use of a CUB domain comprising the amino acid  
15 sequence from position 40 to 150 of the sequence of  
Figure 10, or the amino acid sequence of Figure 26,  
to identify compounds which inhibit angiogenic  
activity in a method according to claim 50.

61. A method of inhibiting angiogenic activity and  
inappropriate vascularisation including formation and  
proliferation of new blood vessels, growth and  
development of tissues, tissue regeneration and organ  
and tissue repair in a subject said method comprising  
25 administering to said subject an amount of a  
polypeptide having an amino acid sequence from  
position 40 to 150 of the sequence illustrated in  
Figure 10 or a nucleic acid molecule according to any  
of claims 39 to 42 in sufficient concentration to  
30 reduce or prevent said angiogenic activity.

62. A method of treating or preventing any of  
cancer, rheumatoid arthritis, psoriasis and diabetic  
retinopathy, said method comprising administering to  
35 said subject an amount of a polypeptide having an  
amino acid sequence from position 40 to 150 of the  
sequence illustrated in Figure 10 or a nucleic acid

- 65 -

molecule according to any of claims 39 to 42 in sufficient concentration to treat or prevent said disorders.

- 5      63. An antisense molecule capable of hybridising to a molecule according to any of claims 39 to 42 under high stringency conditions.
- 10      64. An antisense molecule capable of hybridising to a molecule according to claim 43 under high stringency conditions.
- 15      65. A transgenic cell, tissue or organism comprising a transgene capable of expressing a protein according to claim 48.
- 20      66. A transgenic cell, tissue or organism comprising a transgene capable of expressing a protein according to claim 49.
- 25      67. A transgenic, cell tissue or organism according to claim 65 or 66, wherein said transgene is included in an expression vector according to claim 41 or 42.
- 30      68. An antibody capable of binding to a protein according to claim 48 or an epitope thereof.
- 35      69. An antibody capable of binding to a protein according to claim 49 or an epitope thereof.
70. A pharmaceutical composition comprising an antibody according to claim 68 or 69 together with a pharmaceutically acceptable carrier diluent or excipient therefor.
71. A pharmaceutical composition comprising a

- 66 -

compound according to claim 48 together with a pharmaceutically acceptable carrier, diluent or excipient therefor.

- 5     72. A nucleic acid molecule encoding a variant of a VEGF-X protein having any of the sequences of nucleotides illustrated in Figure 12.

*FIG. 1*

```

1  AAAATGTATG GATACAACCTT ACGTTTGATG AAAGATTGCG GCTTGAAGAC CCAGAAGATG
   TTTTACATAC CTATGTTGAA TGCAAACCTAC TTTCTAAACC CGAACTTCTG GGTCTTCTAC

61  ACATATGCAA GTATGATTTT GTAGAAGTTG AGGAACCCAG TGATGGAAGT ATATTAGGGC
   TGTATACGTT CATACTAAAA CATCTTCAAC TCCTTGCGTC ACTACCTTGA TATAATCCCC

121 GCTGGTGTGG TTCTGGTACT GTACCAGGAA AACAGATTTC TAAAGGAAAT CAAATTAGGA
   CGACCACACC AAGACCATGA CATGGTCCTT TTGTCTAAAG ATTTCCCTTA GTTTAATCCT

+1      MetAsn IlePheLeu LeuAsnLeuLeu ThrGluGlu ValArgLeu
   ]-----
181  TAAGATTGTT ATCTGATGAA TATTTTCCTT CTGAACCTTC TAACAGAGGA GGTAAGATTA
   ATTCTAAACA TAGACTACTT ATAAAAGGAA GACTTGGAAG ATTGTCTCCT CCATTCTAAT

+1  TyrSerCysThr ProArgAsn PheSerVal SerIleArgGlu GluLeuLys ArgThrAsp
   -----
241  TACAGCTGCA CACCTCGTAA CTTCTCAGTG TCCATAAGGG AAGAACTAAA GAGAACCAGT
   ATGTCGACGT GTGGAGCATT GAAGAGTCAC AGGTATTCCC TTCTTGATTT CTCTTGCGTA

+1  ThrIlePheTrp ProGlyCys LeuLeuVal LysArgCysGly GlyAsnCys AlaCysCys
   -----
301  ACCATTTTCT GGCCAGGTTG TCTCCTGGTT AAACGCTGTG GTGGGAACTG TGCCTGTTGT
   TGGTAAAAGA CCGGTCCAAC AGAGGACCAA TTTGCGACAC CACCCTTGAC ACGGACAACA

+1  LeuHisAsnCys AsnGluCys GlnCysVal ProSerLysVal ThrLysLys TyrHisGlu
   -----
361  CTCCACAATT GCAATGAATG TCAATGTGTC CCAAGCAAAG TTAATAAAAA ATACCACGAG
   GAGGTGTTAA CGTTACTTAC AGTTACACAG GGTTCGTTTC AATGATTTT TATGGTGCTC

+1  ValLeuGlnLeu ArgProLys ThrGlyVal ArgGlyLeuHis LysSerLeu ThrAspVal
   -----
421  GTCCTTCAGT TGAGACCAAA GACCGGTGTC AGGGGATTGC ACAAATCACT CACCGACGTG
   CAGGAAGTCA ACTCTGGTTT CTGGCCACAG TCCCTAACG TGTTTAGTGA GTGGCTGCAC

+1  AlaLeuGluHis HisGluGlu CysAspCys ValCysArgGly SerThrGly Gly
   ----->
481  GCCCTGGAGC ACCATGAGGA GTGTGACTGT GTGTGCAGAG GGAGCACAGG AGGATAGCCG
   CGGGACCTCG TGGTACTCCT CACACTGACA CACACGTCTC CCTCGTGTC TCCTATCGGC

541  CATCACCACC AGCAGCTCTT GCCCAGAGCT GTGCAGTGCA GTGGCTGATT CTATTAGAGA
   GTAGTGGTGG TCGTCGAGAA CGGGTCTCGA CACGTCACGT CACCGACTAA GATAATCTCT

601  ACGTATGCGT TATCTCCATC CTTAATCTCA GTTGTGTTGCT TCAAGGACCT TTCATCTTCA
   TGCATACGCA ATAGAGGTAG GAATTAGAGT CAACAAACGA AGTTCCTGGA AAGTAGAAGT

661  GGATTTACAG TGCATTCTGA AAGAGGAGAC ATCAAACAGA ATTAGGAGTT GTGCAACAGC
   CCTAAATGTC ACGTAAGACT TTCTCCTCTG TAGTTTGTCT TAATCTCAA CACGTTGTCT

721  TCTTTTGAGA GGAGGCCTAA AGGACAGGAG AAAAGGTCTT CAATCGTGGA AAGAAAATTA
   AGAAAACCTCT CCTCCGATT TCCTGTCTC TTTTCCAGAA GTTAGCACCT TTCTTTTAAT

781  AATGTTGTAT TAAATAGATC ACCAGCTAGT TTCAGAGTTA CCATGTACGT ATTCCACTAG
   TTACAACATA ATTTATCTAG TGGTCGATCA AAGTCTCAAT GGTACATGCA TAAGGTGATC

```

*FIG. 1 (CONTINUED)*

841 CTGGGTTCTG TATTTTCAGTT CTTTCGATAC GGCTTAGGGT AATGTCAGTA CAGGAAAAAA  
GACCCAAGAC ATAAAGTCAA GAAAGCTATG CCGAATCCCA TTACAGTCAT GTCCTTTTTT

901 ACTGTGCAAG TGAGCACCTG ATTCCGTTGC CTTGCTTAAC TCTAAAGCTC CATGTCCTGG  
TGACACGTTT ACTCGTGGAC TAAGGCAACG GAACGAATTG AGATTTTCGAG GTACAGGACC

961 GCCTAAAATC GTATAAAATC TGGATTTTTT TTTTTTTTTT TGCTCATATT CACATATGTA  
CGGATTTTAG CATATTTTAG ACCTAAAAAA AAAAAAAA ACGAGTATAA GTGTATACAT

1021 AACCAGAACA TTCTATGTAC TACAAACCTG GTTTTTAAAA AGGAACTATG TTGCTATGAA  
TTGGTCTTGT AAGATACATG ATGTTTGGAC CAAAAATTTT TCCTTGATAC AACGATACTT

1081 TTAAACTTGT GTCGTGCTGA TAGGACAGAC TGGATTTTTC ATATTTCTTA TTAAAATTTT  
AATTTGAACA CAGCACGACT ATCCTGTCTG ACCTAAAAAG TATAAAGAAT AATTTTAAAG

1141 TGCCATTTAG AAGAAGAGAA CTACATTCAT GGTTTGGAAG AGATAAACCT GAAAAGAAGA  
ACGGTAAATC TTCTTCTCTT GATGTAAAGTA CCAAACCTTC TCTATTTGGA CTTTCTCTCT

1201 GTGGCCTTAT CTTCACTTTA TCGATAAGTC AGTTTATTTG TTTCAATTGTG TACATTTTTA  
CACCGGAATA GAAGTGAAAT AGCTATTCAG TCAAAATAAC AAAGTAAAC ACATGAAAAAT

1261 TATTCTCCTT TTGACATTAT AACTGTTGGC TTTTCTAATC TTGTTAAATA TATCTATTTT  
ATAAGAGGAA AACTGTAATA TTGACAACCG AAAAGATTAG AACAATTTAT ATAGATAAAA

1321 TACCAAAGGT ATTTAATATT CTTTTTTATG ACAACTTAGA TCAACTATTT TTAGCTTGGT  
ATGGTTTCCA TAAATTATAA GAAAAAATAC TGTGGAATCT AGTTGATAAA AATCGAACCA

1381 AAATTTTTCT AAACACAATT GTTATAGCCA GAGGAACAAA GATGATATAA AATATTGTTG  
TTTAAAAAGA TTTGTGTTAA CAATATCGGT CTCCTTGTTT CTAATATATT TTATAACAAC

1441 CTCTGACAAA AATACATGTA TTTCATTCTC GTATGGTGCT AGAGTTAGAT TAATCTGCAT  
GAGACTGTTT TTATGTACAT AAAGTAAGAG CATAACACGA TCTCAATCTA ATTAGACGTA

1501 TTTAAAAAAC TGAATTGGAA TAGAATTGGT AAGTTGCAAA GACTTTTTGA AAATAATTAA  
AAATTTTTTG ACTTAACCTT ATCTTAACCA TTCAACGTTT CTGAAAAACT TTTATTAATT

1561 ATTATCATAT CTTCCATTCC TGTATTGGA GATGAAAATA AAAAGCAACT TATGAAAGTA  
TAATAGTATA GAAGGTAAGG ACAATAACCT CTACTTTTAT TTTTCGTTGA ATACTTTCAT

1621 GACATTCAGA TCCAGCCATT ACTAACCTAT TCCTTTTTTG GGGAAATCTG AGCCTAGCTC  
CTGTAAGTCT AGGTCGGTAA TGATTGGATA AGGAAAAAAC CCCTTTAGAC TCGGATCGAG

1681 AGAAAAACAT AAAGCACCTT GAAAAAGACT TGGCAGCTTC CTGATAAAGC GTGCTGTGCT  
TCTTTTTGTA TTTCGTGGAA CTTTTTCTGA ACCGTCGAAG GACTATTTCTG CACGACACGA

1741 GTGCAGTAGG AACACATCCT ATTTATTGTG ATGTTGTGGT TTTATTATCT TAAACTCTGT  
CACGTCATCC TTGTGTAGGA TAAATAACAC TACAACACCA AAATAATAGA ATTTGAGACA

1801 TCCATACACT TGTATAAATA CATGGATATT TTTATGTACA GAAGTATGTC TCTTAACGAG  
AGGTATGTGA ACATATTTAT GTACCTATAA AAATACATGT CTTCATACAG AGAATTGGTC

1861 TTCACTTATT GTACCTGG  
AAGTGAATAA CATGGACC

*FIG. 2.* Predicted VEGF-like protein encoded by Incyte contig of 8/12/98

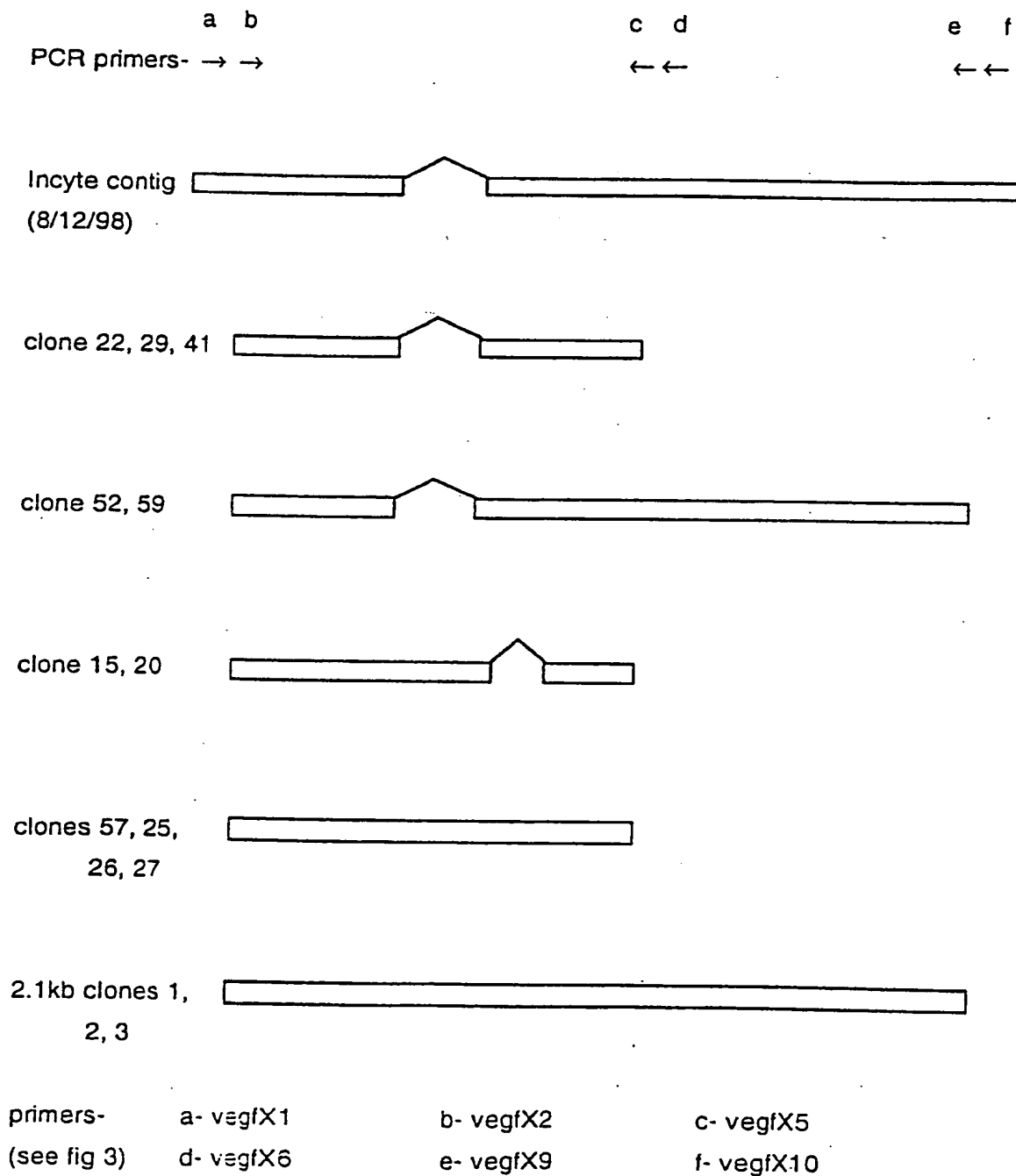
1 MNIFLLNLLT EEVRLYSCTP RNFSVSIREE LKRTDTIFWP GCLLVKRCGG  
51 NCACCLHNCN ECQCVPSKVT KKYHEVLQLR PKTGVRGLHK SLTDVALEHH  
101 EECDCVCRGS TGG

*FIG. 3.* PCR primers for cloning VEGF-X

vegfx1	AAAATGTATGGATACAACTTAC
vegfx2	GTTTGATGAAAGATTTGGGCTTG
vegfx3	TTTCTAAAGGAAATCAAATTAG
vegfx4	GATAAGATTTGTATCTGATG
vegfx5	GATGTCTCCTCTTTCAG
vegfx6	GCACAACTCCTAATTCTG
vegfx7	AGCACCTGATTCCGTTGC
vegfx8	TAGTACATAGAATGTTCTGG
vegfx9	AAGAGACATACTTCTGTAC
vegfx10	CCAGGTACAATAAGTGAAGTGA

FIG. 4.

**Variants isolated by PCR (at 8/2/99, all cloned and sequenced at**





*FIG. 5.* VEGF-X 5' RACE primers

vegX11	CCTTTAGAAATCTGTTTTCTGGTACAG
vegX12	GGAAAATATTCATCAGATACAAATCTTATCC
vegX13	GGTCCAGTGGCAAAGCTGAAGG
vegX14	CTGGTTCAAGATATCGAATAAGGTCTTCC

*FIG. 6.* DNA sequence assembled from in-house clones and 5'RACE

```

1  TGCCAGAGCA GGTGGGCGCT TCCACCCAG TGCAGCCTTC CCCTGGCGGT GGTGAAAGAG
   ACGGTCTCGT CCACCCGCGA AGGTGGGGTC ACGTCGGAAG GGGACCGCCA CCACTTTCTC

61  ACTCGGGAGT CGCTGCTTCC AAAGTGCCCG CCGTGAGTGA GCTCTCACCC CAGTCAGCCA
   TGAGCCCTCA GCGACGAAGG TTTCACGGGC' GGCAC TACT CGAGAGTGGG GTCAGTCGGT

+2  MetSerLeu PheGlyLeuLeu LeuLeuThr SerAlaLeu AlaGlyGlnArg GlnGlyTh
   ]-----
121  AATGAGCCTC TTCGGGCTTC TCCTGCTGAC ATCTGCCCTG GCCGGCCAGA GACAGGGGAC
   TTACTCGGAG AAGCCCGAAG AGGACGACTG TAGACGGGAC CGGCCGGTCT CTGTCCCCTG

+2  rGlnAlaGlu SerAsnLeuSer SerLysPhe GlnPheSer SerAsnLysGlu GlnAsnGl
   -----
181  TCAGGCGGAA TCCAACCTGA GTAGTAAATT CCAGTTTTC AGCAACAAGG AACAGAACGG
   AGTCCGCCCTT AGGTTGGACT CATCATTTAA GGTCAAAAGG TCGTTGTTCC TTGTCTTGCC

+2  yValGlnAsp ProGlnHisGlu ArgIleIle ThrValSer ThrAsnGlySer IleHisSe
   -----
241  AGTACAAGAT CCTCAGCATG AGAGAATTAT TACTGTGTCT ACTAATGGAA GTATTACAG
   TCATGTTCTA GGAGTCGTAC TCTCTTAATA ATGACACAGA TGATTACCTT CATAAGTGTC

+2  rProArgPhe ProHisThrTyr ProArgAsn ThrValLeu ValTrpArgLeu ValAlaVa
   -----
301  CCCAAGGTTT CCTCATACTT ATCCAAGAAA TACGGTCTTG GTATGGAGAT TAGTAGCAGT
   GGGTTCCAAA GGAGTATGAA TAGGTTCTTT ATGCCAGAAC CATACCTCTA ATCATCGTCA

+2  lGluGluAsn ValTrpIleGln LeuThrPhe AspGluArg PheGlyLeuGlu AspProGl
   -----
361  AGAGGAAAAT GTATGGATAC AACTTACGTT TGATGAAAGA TTTGGGCTTG AAGACCCAGA
   TCTCCTTTTA CATACCTATG TTGAATGCAA ACTACTTTCT AAACCCGAAC TTCTGGGTCT

+2  uAspAspIle CysLysTyrAsp PheValGlu ValGluGlu ProSerAspGly ThrIleLe
   -----
421  AGATGACATA TGCAAGTATG ATTTTGTAGA AGTTGAGGAA CCCAGTGATG GAACTATATT
   TCTACTGTAT ACGTTCATAC TAAACATCT TCAACTCCTT GGGTCACTAC CTTGATATAA

+2  uGlyArgTrp CysGlySerGly ThrValPro GlyLysGln IleSerLysGly AsnGlnIl
   -----
481  AGGGCGCTGG TGTGGTCTCG GTACTGTACC AGGAAAACAG ATTTCTAAAG GAAATCAAAT
   TCCC CGCACC ACACCAAGAC CATGACATGG TCCTTTTGTC TAAAGATTTC CTTTAGTTTA

+2  eArgIleArg PheValSerAsp GluTyrPhe ProSerGlu ProGlyPheCys IleHisTy
   -----
541  TAGGATAAGA TTTGTATCTG ATGAATATTT TCCTTCTGAA CCAGGGTTCT GCATCCACTA
   ATCCTATTCT AAACATAGAC TACTTATAAA AGGAAGACTT GGTCCAAGA CGTAGGTGAT

+2  rAsnIleVal MetProGlnPhe ThrGluAla ValSerPro SerValLeuPro ProSerAl
   -----
601  CAACATTGTC ATGCCACAAT TCACAGAAGC TGTGAGTCCT TCAGTGCTAC CCCCTTCAGC
   GTTGTAACAG TACGGTGTTA AGTGTCTTCG AACTCAGGA AGTCACGATG GGGGAAGTCG

+2  aLeuProLeu AspLeuLeuAsn AsnAlaIle ThrAlaPhe SerThrLeuGlu AspLeuIl
   -----
661  TTTGCCACTG GACCTGCTTA ATAATGCTAT AACTGCCTTT AGTACCTTG GAGACCTTAT

```

*FIG. 6 (CONTINUED 1).*

+2 eArgTyrLeu GluProGluArg TrpGlnLeu AspLeuGlu AspLeuTyrArg ProThrTr  
-----  
721 TCGATATCTT GAACCAGAGA GATGGCAGTT GGACTTAGAA GATCTATATA GGCCAACTTG  
AGCTATAGAA CTTGGTCTCT CTACCGTCAA CCTGAATCTT CTAGATATAT CCGGTTGAAC

+2 pGlnLeuLeu GlyLysAlaPhe ValPheGly ArgLysSer ArgValValAsp LeuAsnLe  
-----  
781 GCAACTTCTT GGCAAGGCTT TTGTTTTTGG AAGAAAATCC AGAGTGGTGG ATCTGAACCT  
CGTTGAAGAA CCGTTCCGAA AACAAAAACC TTCTTTTAGG TCTCACCACC TAGACTTGGA

+2 uLeuThrGlu GluValArgLeu TyrSerCys ThrProArg AsnPheSerVal SerIleAr  
-----  
841 TCTAACAGAG GAGGTAAGAT TATACAGCTG CACACCTCGT AACTTCTCAG TGTCCATAAG  
AGATTGTCTC CTCCATTCTA ATATGTCGAC GTGTGGAGCA TTGAAGAGTC ACAGGTATTC

+2 gGluGluLeu LysArgThrAsp ThrIlePhe TrpProGly CysLeuLeuVal LysArgCy  
-----  
901 GGAAGAACTA AAGAGAACCG ATACCATTTT CTGGCCAGGT TGTCTCCTGG TTAAACGCTG  
CCTTCTTGAT TTCTCTTGGC TATGGTAAAA GACCGGTCCA ACAGAGGACC AATTTGCGAC

+2 sGlyGlyAsn CysAlaCysCys LeuHisAsn CysAsnGlu CysGlnCysVal ProSerLy  
-----  
961 TGGTGGGAAC TGTGCCTGTT GTCTCCACAA TTGCAATGAA TGTCATGTG TCCCAAGCAA  
ACCACCCTTG ACACGGACAA CAGAGGTGTT AACGTTACTT ACAGTTACAC AGGGTTCGTT

+2 sValThrLys LysTyrHisGlu ValLeuGln LeuArgPro LysThrGlyVal ArgGlyLe  
-----  
1021 AGTTACTAAA AAATACCACG AGGTCCTTCA GTTGAGACCA AAGACCGGTG TCAGGGGATT  
TCAATGATTT TTTATGGTGC TCCAGGAAGT CAACTCTGGT TTCTGGCCAC AGTCCCCATA

+2 uHisLysSer LeuThrAspVal AlaLeuGlu HisHisGlu GluCysAspCys ValCysAr  
-----  
1081 GCACAAATCA CTCACCGACG TGGCCCTGGA GCACCATGAG GAGTGTGACT GTGTGTGCAG  
CGTGTCTTAGT GAGTGGCTGC ACCGGGACCT CGTGGTACTC CTCACACTGA CACACACGTC

+2 gGlySerThr GlyGly  
----->  
1141 AGGGAGCACA GGAGGATAGC CGCATCACCA CCAGCAGCTC TTGCCCAGAG CTGTGCAGTG  
TCCCTCGTGT CCTCCTATCG GCGTAGTGGT GGTCGTCGAG AACGGGTCTC GACACGTCAC

1201 CAGTGGCTGA TTCTATTAGA GAACGTATGC GTTATCTCCA TCCTTAATCT CAGTTGTTTG  
GTCACCGACT AAGATAATCT CTTGCATACG CAATAGAGGT AGGAATTAGA GTCAACAAAC

1261 CTTCAAGGAC CTTTCATCTT CAGGATTTAC AGTGCATTCT GAAAGAGGAG ACATCAAACA  
GAAGTTCCTG GAAAGTAGAA GTCCTAAATG TCACGTAAGA CTTTCTCCTC TGTAGTTTGT

1321 GAATTAGGAG TTGTGCAACA GCTCTTTTGA GAGGAGGCCT AAAGGACAGG AGAAAAGGTC  
CTTAATCCTC AACACGTTGT CGAGAAAACCT CTCTCCGGA TTTCTGTCC TCTTTTCCAG

1381 TTCAATCGTG GAAAGAAAAT TAAATGTTGT ATTAAATAGA TCACCAGCTA GTTTCAGAGT  
AAGTTAGCAC CTTTCTTTTA ATTTACAACA TAATTTATCT AGTGGTCGAT CAAAGTCTCA

1441 TACCATGTAC GTATTCCACT AGCTGGGTTT TGTATTTTCTG TTTCTTCGAT ACGGCTTAGG  
ATGGTACATG CATAAGGTGA TCGACCCAAG ACATAAAGTC AAGAAAGCTA TGCCGAATCC

1501 GTAATGTCAG TACAGGAAAA AAACGTGCA AGTGAGCACC TGATTCCGTT GCCTTGCTTA  
-----

*FIG. 6 (CONTINUED 2).*

1561 ACTCTAAAGC TCCATGTCCT GGGCCTAAAA TCGTATAAAA TCTGGATTTT TTTTTTTTTT  
 TGAGATTTTCG AGGTACAGGA CCCGGATTTT AGCATATTTT AGACCTAAAA AAAAAAAAAA  
  
 1621 TTTGCTCATA TTCACATATG TAAACCAGAA CATTCTATGT ACTACAAACC TGGTTTTTAA  
 AAACGAGTAT AAGTGTATAC ATTTGGTCTT GTAAGATACA TGATGTTTGG ACCAAAAATT  
  
 1681 AAAGGAACTA TGTTGCTATG AATTAACTT GTGTCGTGCT GATAGGACAG ACTGGATTTT  
 TTTCTTGAT ACAACGATAC TTAATTTGAA CACAGCACGA CTATCCTGTC TGACCTAAAA  
  
 1741 TCATATTTCT TATTAAAATT TCTGCCATTT AGAAGAAGAG AACTACATTC ATGGTTTGG  
 AGTATAAAGA ATAATTTTAA AGACGGTAAA TCTTCTTCTC TTGATGTAAG TACCAAACCT  
  
 1801 AGAGATAAAC CTGAAAAGAA GAGTGGCCTT ATCTTCACTT TATCGATAAG CCAGTTTATT  
 TCTCTATTTG GACTTTTCTT CTCACCGGAA TAGAAGTGAA ATAGCTATTC GGTCAAATAA  
  
 1861 TGTTTCATTG TGTACATTTT TATATTCTCC TTTTGACATT ATAAGTGTG GCTTTTCTAA  
 ACAAAGTAAC ACATGTAAAA ATATAAGAGG AAAACTGTAA TATTGACAAC CGAAAAGATT  
  
 1921 TCTTGTTAAA TATATCTATT TTTACCAAAG GTATTTAATA TTCTTTTTTA TGACAACTTA  
 AGAACAATTT ATATAGATAA AAATGGTTTC CATAAATTAT AAGAAAAAAT ACTGTTGAAT  
  
 1981 GATCAACTAT TTTTAGCTTG GTAAATTTTT CTAAACACAA TTGTTATAGC CAGAGGAACA  
 CTAGTTGATA AAAATCGAAC CATTTAAAAA GATTTGTGTT AACAATATCG GTCTCCTTGT  
  
 2041 AAGATGATAT AAAATATTGT TGCTCTGACA AAAATACATG TATTTTCATTC TCGTATGGTG  
 TTCTACTATA TTTTATAACA ACGAGACTGT TTTTATGTAC ATAAAGTAAG AGCATACCAC  
  
 2101 CTAGAGTTAG ATTAATCTGC ATTTTAAAAA ACTGAATTGG AATAGAATTG GTAAGTTGCA  
 GATCTCAATC TAATTAGACG TAAAATTTTT TGACTTAACC TTATCTTAAC CATTCAACGT  
  
 2161 AAGACTTTTT GAAAATAATT AAATTATCAT ATCTTCCATT CCTGTTATTG GAGATGAAAA  
 TTCTGAAAAA CTTTATTAA TTTAATAGTA TAGAAGGTAA GGACAATAAC CTCTACTTTT  
  
 2221 TAAAAAGCAA CTTATGAAAG TAGACATTCA GATCCAGCCA TTAATAACCT ATTCCTTTTT  
 ATTTTTCGTT GAATACTTTC ATCTGTAAGT CTAGGTCGGT AATGATTGGA TAAGGAAAAA  
  
 2281 TGGGGAAATC TGAGCCTAGC TCAGAAAAAC ATAAAGCACC TTGAAAAAGA CTTGGCAGCT  
 ACCCTTTTAG ACTCGGATCG AGTCTTTTTG TATTTTCGTG AACTTTTTCT GAACCGTCGA  
  
 2341 TCCTGATAAA GCGTGCTGTG CTGTGCAGTA GGAACACATC CTATTTATTG TGATGTTGTG  
 AGGACTATTT CGCACGACAC GACACGTCAT CCTTGTGTAG GATAAATAAC ACTACAACAC  
  
 2401 GTTTTATTAT CTTAACTCT GTTCCATACA CTTGTATAAA TACATGGATA TTTTATGTA  
 CAAAATAATA GAATTTGAGA CAAGGTATGT GAACATATTT ATGTACCTAT AAAAATACAT  
  
 2461 CAGAAGTATG TCTCT  
 GTCTTCATAC AGAGA

*FIG. 7.*

## New Sequence + Incyte ESTs

```

1  ATTTGTTTAA ACCTTGGGAA ACTGGTTCAG GTCCAGGTTT TGCTTTGATC CTTTTCAAAA
   TAAACAAATT TGGAACCCTT TGACCAAGTC CAGGTCCAAA ACGAAACTAG GAAAAGTTTT

61  ACTGGAGACA CAGAAGAGGG CTTCTAGGAA AAAGTTTTGG GATGGGATTA TGTGGAAACT
   TGACCTCTGT GTCTTCTCCC GAAGATCCTT TTTCAAACC CTACCCTAAT ACACCTTTGA

121 ACCCTGCGAT TCTCTGCTGC CAGAGCAGGC TCGGCGCTTC CACCCAGTG CAGCCTTCCC
   TGGGACGCTA AGAGACGACG GTCTCGTCCG AGCCGCGAAG GTGGGGTCAC GTCGGAAGGG

181 CTGGCGGTGG TGAAAGAGAC TCGGGAGTCG CTGCTTCCAA AGTGCCCGCC GTGAGTGAGC
   GACCGCCACC ACTTCTCTG AGCCCTCAGC GACGAAGGTT TCACGGGCGG CACTCACTCG

+2                               Met SerLeuPhe GlyLeuLeu LeuLeuThrSer AlaLeuAl
                               }-----
241 TCTACCCCA GTCAGCCAAA TGAGCCTCTT CGGGCTTCTC CTGCTGACAT CTGCCCTGGC
   AGAGTGGGGT CAGTCGGTTT ACTCGGAGAA GCCCGAAGAG GACGACTGTA GACGGGACCG

+2 aGlyGlnArg GlnGlyThrGln AlaGluSer AsnLeuSer SerLysPheGln PheSerSe
   -----
301 CGGCCAGAGA CAGGGGACTC AGGCGGAATC CAACCTGAGT AGTAAATTCC AGTTTTCCAG
   GCCGGTCTCT GTCCCCTGAG TCCGCCTTAG GTTGGACTCA TCATTTAAGG TCAAAAGGTC

+2 rAsnLysGlu GlnTyrGlyVal GlnAspPro GlnHisGlu ArgIleIleThr ValSerTh
   -----
361 CAACAAGGAA CAGTACGGAG TACAAGATCC TCAGCATGAG AGAATTATTA CTGTGTCTAC
   GTTGTTCCTT GTCATGCCTC ATGTTCTAGG AGTCGTA CTCCTAATAAT GACACAGATG

+2 rAsnGlySer IleHisSerPro ArgPhePro HisThrTyr ProArgAsnThr ValLeuVa
   -----
421 TAATGGAAGT ATTCACAGCC CAAGGTTTCC TCATACTTAT CCAAGAAATA CGGTCTTGGT
   ATTACCTTCA TAAGTGTCGG GTTCCAAAGG AGTATGAATA GGTTCCTTAT GCCAGAACCA

+2 lTrpArgLeu ValAlaValGlu GluAsnVal TrpIleGln LeuThrPheAsp GluArgPh
   -----
481 ATGGAGATTA GTAGCAGTAG AGGAAAATGT ATGGATACAA CTTACGTTTG ATGAAAGATT
   TACCTCTAAT CATCGTCATC TCCTTTTACA TACCTATGTT GAATGCAAAC TACTTTCTAA

+2 eGlyLeuGlu AspProGluAsp AspIleCys LysTyrAsp PheValGluVal GluGluPr
   -----
541 TGGGCTTGAA GACCCAGAAG ATGACATATG CAAGTATGAT TTTGTAGAAG TTGAGGAACC
   ACCCGAACTT CTGGGTCTTC TACTGTATAC GTTCATACTA AAACATCTTC AACTCCTTGG

+2 oSerAspGly ThrIleLeuGly ArgTrpCys GlySerGly ThrValProGly LysGlnIl
   -----
601 CAGTGATGGA ACTATATTAG GCGCTGGTG TGGTCTGGT ACTGTACCAG GAAAACAGAT
   GTCACTACCT TGATATAATC CCGCGACCAC ACCAAGACCA TGACATGGTC CTTTGTCTA

+2 eSerLysGly AsnGlnIleArg IleArgPhe ValSerAsp GluTyrPhePro SerGluPr
   -----
661 TTCTAAAGGA AATCAAATTA GGATAAGATT TGTATCTGAT GAATATTTTC CTTCTGAACC
   AAGATTTCCT TTAGTTTAAT CCTATTCTAA ACATAGACTA CTTATAAAAG GAAGACTTGG

```

*FIG. 7(CONTINUED 1).*

```

+2 oGlyPheCys IleHisTyrAsn IleValMet ProGlnPhe ThrGluAlaVal SerProSe
-----
721 AGGGTTCTGC ATCCACTACA ACATTGTCAT GCCACAATTC ACAGAAGCTG TGAGTCCTTC
    TCCCAAGACG TAGGTGATGT TGTAACAGTA CGGTGTTAAG TGTCTTCGAC ACTCAGGAAG

+2 rValLeuPro ProSerAlaLeu ProLeuAsp LeuLeuAsn AsnAlaIleThr AlaPheSe
-----
781 AGTGCTACCC CCTTCAGCTT TGCCACTGGA CCTGCTTAAT AATGCTATAA CTGCCTTTAG
    TCACGATGGG GGAAGTCGAA ACGGTGACCT GGACGAATTA TTACGATATT GACGGAAATC

+2 rThrLeuGlu AspLeuIleArg TyrLeuGlu ProGluArg TrpGlnLeuAsp LeuGluAs
-----
841 TACCTTGGAA GACCTTATTC GATATCTTGA ACCAGAGAGA TGGCAGTTGG ACTTAGAAGA
    ATGGAACCTT CTGGAATAAG CTATAGAACT TGGTCTCTCT ACCGTCAACC TGAATCTTCT

+2 pLeuTyrArg ProThrTrpGln LeuLeuGly LysAlaPhe ValPheGlyArg LysSerAr
-----
901 TCTATATAGG CCAACTTGGC AACTTCTTGG CAAGGCTTTT GTTTTTGGAA GAAAATCCAG
    AGATATATCC GGTGGAACCG TTGAAGAACC GTTCCGAAAA CAAAACCTT CTTTTAGGTC

+2 gValValAsp LeuAsnLeuLeu ThrGluGlu ValArgLeu TyrSerCysThr ProArgAs
-----
961 AGTGGTGGAT CTGAACCTTC TAACAGAGGA GGTAAGATTA TACAGCTGCA CACCTCGTAA
    TCACCACCTA GACTTGGAAG ATTGTCTCCT CCATTCTAAT ATGTCGACGT GTGGAGCATT

+2 nPheSerVal SerIleArgGlu GluLeuLys ArgThrAsp ThrIlePheTrp ProGlyCy
-----
1021 CTTCTCAGTG TCCATAAGGG AAGAACTAAA GAGAACCGAT ACCATTTTCT GGCCAGGTTG
    GAAGAGTCAC AGGTATTCCC TTCTTGATTT CTCTTGGCTA TGGTAAAAGA CCGGTCCAAC

+2 sLeuLeuVal LysArgCysGly GlyAsnCys AlaCysCys LeuHisAsnCys AsnGluCy
-----
1081 TCTCTGGTGT AAACGCTGTG GTGGGAACTG TGCCTGTTGT CTCCACAATT GCAATGAATG
    AGAGGACCAA TTTGCGACAC CACCCTTGAC ACGGACAACA GAGGTGTTAA CGTTACTTAC

+2 sGlnCysVal ProSerLysVal ThrLysLys TyrHisGlu ValLeuGlnLeu ArgProLy
-----
1141 TCAATGTGTC CCAAGCAAAG TTAATAAAAA ATACCACGAG GTCCTTCAGT TGAGACCAAA
    AGTTACACAG GGTTCGTTTC AATGATTTTT TATGGTGCTC CAGGAAGTCA ACTCTGGTTT

+2 sThrGlyVal ArgGlyLeuHis LysSerLeu ThrAspVal AlaLeuGluHis HisGluGl
-----
1201 GACCGGTGTC AGGGGATTGC ACAAATCACT CACCGACGTG GCCCTGGAGC ACCATGAGGA
    CTGGCCACAG TCCCCTAACG TGTTTAGTGA GTGGCTGCAC CGGGACCTCG TGGTACTCCT

+2 uCysAspCys ValCysArgGly SerThrGly Gly
----->
1261 GTGTGACTGT GTGTGCAGAG GGAGCACAGG AGGATAGCCG CATCACCACC AGCAGCTCTT
    CACACTGACA CACACGTCTC CCTCGTGTC TCCTATCGGC GTAGTGGTGG TCGTCGAGAA

1321 GCCCAGAGCT GTGCAGTGCA GTGGCTGATT CTATTAGAGA ACGTATGCGT TATCTCCATC
    CGGGTCTCGA CACGTCACGT CACCGACTAA GATAATCTCT TGCATACGCA ATAGAGGTAG

1381 CTTAATCTCA GTTGTTTGCT TCAAGGACCT TTCATCTTCA GGATTTACAG TGCATTCTGA
    GAATTAGAGT CAACAAACGA AGTTCCTGGA AAGTAGAAGT CCTAAATGTC ACGTAAGACT

```

*FIG. 7 (CONTINUED 2)*

1441	AAGAGGAGAC	ATCAAACAGA	ATTAGGAGTT	GTGCAACAGC	TCTTTTGAGA	GGAGGCCTAA
	TTCTCCTCTG	TAGTTTGTCT	TAATCCTCAA	CACGTTGTCG	AGAAAACCTCT	CCTCCGATT
1501	AGGACAGGAG	AAAAGGTCTT	CAATCGTGGA	AAGAAAATTA	AATGTTGTAT	TAAATAGATC
	TCCTGTCCTC	TTTTCCAGAA	GTTAGCACCT	TTCTTTTAAT	TTACAACATA	ATTTATCTAG
1561	ACCAGCTAGT	TTCAGAGTTA	CCATGTACGT	ATTCCACTAG	CTGGGTTCTG	TATTTTCAGTT
	TGGTCGATCA	AAGTCTCAAT	GGTACATGCA	TAAGGTGATC	GACCCAAGAC	ATAAAGTCAA
1621	CTTTCGATAC	GGCTTAGGGT	AATGTCAGTA	CAGGAAAAAA	ACTGTGCAAG	TGAGCACCTG
	GAAAGCTATG	CCGAATCCCA	TTACAGTCAT	GTCCTTTTTT	TGACACGTTT	ACTCGTGAC
1681	ATTCCGTTGC	CTTGGCTTAA	CTCTAAAGCT	CCATGTCCTG	GGCCTAAAAT	CGTATAAAAT
	TAAGGCAACG	GAACCGAATT	GAGATTTCGA	GGTACAGGAC	CCGGATTTTA	GCATATTTTA
1741	CTGGATTTTT	TTTTTTTTTT	TTGCGCATAT	TCACATATGT	AAACCAGAAC	ATTCTATGTA
	GACCTAAAAA	AAAAAAAAAA	AACGCGTATA	AGTGTATACA	TTTGGTCTTG	TAAGATACAT
1801	CTACAAACCT	GGTTTTTAAA	AAGGAACTAT	GTTGCTATGA	ATTAAACTTG	TGTCATGCTG
	GATGTTTGGA	CCAAAAATTT	TTCCTTGATA	CAACGATACT	TAATTTGAAC	ACAGTACGAC
1861	ATAGGACAGA	CTGGATTTTT	CATATTTCTT	ATTAAAAATTT	CTGCCATTTA	GAAGAAGAGA
	TATCCTGTCT	GACCTAAAAA	GTATAAAGAA	TAATTTTAAA	GACGGTAAAT	CTTCTTCTCT
1921	ACTACATTCA	TGGTTTGGA	GAGATAAACC	TGAAAAGAAG	AGTGGCCTTA	TCTTCACTTT
	TGATGTAAGT	ACCAAACCTT	CTCTATTG	ACTTTTCTTC	TCACCGGAAT	AGAAGTGAAA
1981	ATCGATAAGT	CAGTTTATTT	GTTTCATTGT	GTACATTTTT	ATATTCTCCT	TTTGACATTA
	TAGCTATTCA	GTCAAATAAA	CAAAGTAACA	CATGTAAAAA	TATAAGAGGA	AAACTGTAAT
2041	TAACTGTTGG	CTTTTCTAAT	CTTGTTAAAT	ATATCTATTT	TTACCAAAGG	TATTTAATAT
	ATTGACAACC	GAAAAGATTA	GAACAATTTA	TATAGATAAA	AATGGTTTCC	ATAAATTATA
2101	TCTTTTTTAT	GACAACTTAG	ATCAACTATT	TTTAGCTTGG	TAAATTTTTT	TAAACACAAT
	AGAAAAAATA	CTGTTGAATC	TAGTTGATAA	AAATCGAACC	ATTTAAAAAG	ATTTGTGTTA
2161	TGTTATAGCC	AGAGGAACAA	AGATGATATA	AAATATTGTT	GCTCTGACAA	AAATACATGT
	ACAAATACGG	TCTCCTTGTT	TCTACTATAT	TTTATAACAA	CGAGACTGTT	TTTATGTACA
2221	ATTTCACTCT	CGTATGGTGC	TAGAGTTAGA	TTAATCTGCA	TTTTAAAAAA	CTGAATTGGA
	TAAAGTAAGA	GCATACCACG	ATCTCAATCT	AATTAGACGT	AAAATTTTTT	GACTTAACCT
2281	ATAGAATTGG	TAAGTTGCAA	AGACTTTTTT	AAAATAATTA	AATTATCATA	TCTTCCATTCT
	TATCTTAACC	ATTCAACGTT	TCTGAAAAAC	TTTTATTAAAT	TTAATAGTAT	AGAAGGTAAG
2341	CTGTTATTGG	AGATGAAAAT	AAAAAGCAAC	TTATGAAAGT	AGACATTGAG	ATCCAGCCAT
	GACAATAACC	TCTACTTTTA	TTTTTCGTTG	AATACTTTCA	TCTGTAAGTC	TAGGTCGGTA
2401	TACTAACCTA	TTCTTTTTTT	GGGGAAATCT	GAGCCTAGCT	CAGAAAAACA	TAAAGCACCT
	ATGATTGGAT	AAGGAAAAAA	CCCCTTTAGA	CTCGGATCGA	GTCTTTTTGT	ATTTCTGTGA
2461	TGAAAAAGAC	TTGGCAGCTT	CCTGATAAAG	CGTGCTGTGC	TGTGCAGTAG	GAACACATCC
	ACTTTTCTG	AACCGTCGAA	GGACTATTTT	GCACGACACG	ACACGTCATC	CTTGTGTAGG
2521	TATTTATTGT	GATGTTGTGG	TTTTATTATC	TTAAACTCTG	TTCCATACAC	TTGTATAAAT
	ATAAATAACA	CTACAACACC	AAAATAATAG	AATTTGAGAC	AAGGTATGTG	AACATATTTA

*FIG. 7(CONTINUED 3).*

2581 ACATGGATAT TTTTATGTAC AGAAGTATGT CTCTTAACCA GTTCACTTAT TGTACTCTGG  
TGTACCTATA AAAATACATG TCTTCATACA GAGAATTGGT CAAGTGAATA ACATGAGACC

2641 CAATTTAAAA GAAAATCAGT AAAATATTTT GCTTGTAATA TGCTTAATAT CGTGCCTAGG  
GTAAATTTT CTTTATAGTCA TTTTATAAAA CGAACATTTT ACGAATTATA GCACGGATCC

2701 TTATGTGGTG ACTATTTGAA TCAAAAATGT ATTGAATCAT CAAATAAAAG AATGTGGCTA  
AATACACCAC TGATAAACTT AGTTTTTACA TAACTTAGTA GTTTATTTTC TTACACCGAT

2761 TTTTGGGGAG AAAATT  
AAAACCCCTC TTTTAA

*FIG. 8.* Additional oligonucleotides used for amplification of entire coding region

5'-1 TTGTTTAAACCTTGGGAAACTGG

5'-2 GTCCAGGTTTTGCTTTGATCC



**FIG. 9.** DNA Sequence Of Clones 4 & 7, Identical Clones Containing The Entire Open Reading Frame

```

1  TTTGTTTAAA CCTTGGGAAA CTGGTTCAGG TCCAGGTTTT GCTTTGATCC TTTTCAAAAA
   AAACAAATTT GGAACCTTTT GACCAAGTCC AGGTCCAAAA CGAAACTAGG AAAAGTTTTT

61  CTGGAGACAC AGAAGAGGGC TCTAGGAAAA AGTTTTGGAT GGGATTATGT GGAAACTACC
   GACCTCTGTG TCTTCTCCCG AGATCCTTTT TCAAAACCTA CCCTAATACA CCTTTGATGG

121 CTGCGATTCT CTGCTGCCAG AGCAGGCTCG GCGCTTCCAC CCCAGTGCAG CCTTCCCCTG
   GACGCTAAGA GACGACGGTC TCGTCCGAGC CGCGAAGGTG GGGTCACGTC GGAAGGGGAC

181 GCGGTGGTGA AAGAGACTCG GGAGTCGCTG CTTCCAAAGT GCCCGCCGTG AGTGAGCTCT
   CGCCACCACT TTCTCTGAGC CCTCAGCGAC GAAGGTTTCA CGGGCGGCAC TCACTCGAGA

+2                               MetSer LeuPheGly LeuLeuLeu LeuThrSerAla LeuAlaGl
                               }-----
241 CACCCCAGTC AGCCAAATGA GCCTCTTCGG GCTTCTCCTG CTGACATCTG CCCTGGCCGG
   GTGGGGTCAG TCGGTTTACT CGGAGAAGCC CGAAGAGGAC GACTGTAGAC GGGACCGGCC

+2 yGlnArgGln GlyThrGlnAla GluSerAsn LeuSerSer LysPheGlnPhe SerSerAs
-----
301 CCAGAGACAG GGGACTCAGG CGGAATCCAA CCTGAGTAGT AAATTCCAGT TTTCCAGCAA
   GGTCTCTGTC CCCTGAGTCC GCCTTAGGTT GGACTCATCA TTTAAGGTCA AAAGGTCGTT

+2 nLysGluGln AsnGlyValGln AspProGln HisGluArg IleIleThrVal SerThrAs
-----
361 CAAGGAACAG AACGGAGTAC AAGATCCTCA GCATGAGAGA ATTATTACTG TGTCTACTAA
   GTTCCTTGTC TTGCCTCATG TTCTAGGAGT CGTACTCTCT TAATAATGAC ACAGATGATT

+2 nGlySerIle HisSerProArg PheProHis ThrTyrPro ArgAsnThrVal LeuValTr
-----
421 TGGAAGTATT CACAGCCCAA GGTTCCTCA TACTTATCCA AGAAATACGG TCTTGGTATG
   ACCTTCATAA GTGTCGGGTT CCAAAGGAGT ATGAATAGGT TCTTTATGCC AGAACCATAC

+2 pArgLeuVal AlaValGluGlu AsnValTrp IleGlnLeu ThrPheAspGlu ArgPheGl
-----
481 GAGATTAGTA GCAGTAGAGG AAAATGTATG GATACAACCTT ACGTTTGATG AAAGATTTGG
   CTCTAATCAT CGTCATCTCC TTTTACATAC CTATGTTGAA TGCAAACCTAC TTTCTAAACC

+2 yLeuGluAsp ProGluAspAsp IleCysLys TyrAspPhe ValGluValGlu GluProSe
-----
541 GCTTGAAGAC CCAGAAGATG ACATATGCAA GTATGATTTT GTAGAAGTTG AGGAACCCAG
   CGAACTTCTG GGTCTTCTAC TGTATACGTT CATACTAAAA CATCTTCAAC TCCTTGGGTC

+2 rAspGlyThr IleLeuGlyArg TrpCysGly SerGlyThr ValProGlyLys GlnIleSe
-----
601 TGATGGAACCT ATATTAGGGC GCTGGTGTGG TTCTGGTACT GTACCAGGAA AACAGATTTC
   ACTACCTTGA TATAATCCCG CGACCACACC AAGACCATGA CATGGTCCTT TTGTCTAAAG

+2 rLysGlyAsn GlnIleArgIle ArgPheVal SerAspGlu TyrPheProSer GluProGl
-----
661 TAAAGGAAAT CAAATTAGGA TAAGATTTGT ATCTGATGAA TATTTTCCTT CTGAACCAGG
   ATTTCCCTTA GTTAAATCCT ATTCTAAACA TAGACTACTT ATAAAAGGAA GACTTGGTCC

```

*FIG. 9(CONTINUED).*

```

+2 yPheCysIle HisTyrAsnIle ValMetPro GlnPheThr GluAlaValSer ProSerVa
-----
721 GTTCTGCATC CACTACAACA TTGTCATGCC ACAATTCACA GAAGCTGTGA GTCCTTCAGT
CAAGACGTAG GTGATGTTGT AACAGTACGG TGTTAAGTGT CTTCGACACT CAGGAAGTCA

+2 lLeuProPro SerAlaLeuPro LeuAspLeu LeuAsnAsn AlaIleThrAla PheSerTh
-----
781 GCTACCCCTC TCAGCTTTGC CACTGGACCT GCTTAATAAT GCTATAACTG CCTTTAGTAC
CGATGGGGGA AGTCGAAACG GTGACCTGGA CGAATTATTA CGATATTGAC GGAAATCATG

+2 rLeuGluAsp LeuIleArgTyr LeuGluPro GluArgTrp GlnLeuAspLeu GluAspLe
-----
841 CTTGGAAGAC CTTATTCGAT ATCTTGAACC AGAGAGATGG CAGTTGGACT TAGAAGATCT
GAACCTTCTG GAATAAGCTA TAGAACTTGG TCTCTCTACC GTCAACCTGA ATCTTCTAGA

+2 uTyrArgPro ThrTrpGlnLeu LeuGlyLys AlaPheVal PheGlyArgLys SerArgVa
-----
901 ATATAGGCCA ACTTGGCAAC TTCTTGGCAA GGCTTTTGTT TTTGGAAGAA AATCCAGAGT
TATATCCGGT TGAACCGTTG AAGAACCGTT CCGAAAACAA AAACCTTCTT TTAGGTCTCA

+2 lValAspLeu AsnLeuLeuThr GluGluVal ArgLeuTyr SerCysThrPro ArgAsnPh
-----
961 GGTGGATCTG AACCTTCTAA CAGAGGAGGT AAGATTATAC AGCTGCACAC CTCGTAACCT
CCACCTAGAC TTGGAAGATT GTCTCCTCCA TTCTAATATG TCGACGTGTG GAGCATTGAA

+2 eSerValSer IleArgGluGlu LeuLysArg ThrAspThr IlePheTrpPro GlyCysLe
-----
1021 CTCAGTGTCC ATAAGGGAAG AACTAAAGAG AACCGATACC ATTTTCTGGC CAGGTTGTCT
GAGTCACAGG TATTCCTTC TTGATTTCTC TTGGCTATGG TAAAAGACCG GTCCAACAGA

+2 uLeuValLys ArgCysGlyGly AsnCysAla CysCysLeu HisAsnCysAsn GluCysGl
-----
1081 CCTGGTTAAA CGCTGTGGTG GGAAGTGTGC CTGTTGTCTC CACAATTGCA ATGAATGTCA
GGACCAATTT GCGACACCAC CCTTGACACG GACAACAGAG GTGTTAACGT TACTTACAGT

+2 nCysValPro SerLysValThr LysLysTyr HisGluVal LeuGlnLeuArg ProLysTh
-----
1141 ATGTGTCCCA AGCAAAGTTA CTAAAAATA CCACGAGGTC CTTCAAGTTGA GACCAAAGAC
TACACAGGGT TCGTTTCAAT GATTTTTTAT GGTGCTCCAG GAAGTCAACT CTGGTTTCTG

+2 rGlyValArg GlyLeuHisLys SerLeuThr AspValAla LeuGluHisHis GluGluCy
-----
1201 CGGTGTCAGG GGATTGCACA AATCACTCAC CGACGTGGCC CTGGAGCACC ATGAGGAGTG
GCCACAGTCC CTAACGTGT TTAGTGAGTG GCTGCACCGG GACCTCGTGG TACTCCTCAC

+2 sAspCysVal CysArgGlySer ThrGlyGly
----->
1261 TGAAGTGTG TGCAGAGGGA GCACAGGAGG ATAGCCGCAT CACCACCAGC AGCTCTTGCC
ACTGACACAC ACGTCTCCCT CGTGCTCTCC TATCGGCGTA GTGGTGGTCG TCGAGAACGG

1321 CAGAGCTGTG CAGTGCAGTG GCTGATTCTA TTAGAGAACG TATGCGTTAT CTCCATCCTT
GTCTCGACAC GTCACGTCAC CGACTAAGAT AATCTCTTGC ATACGCAATA GAGGTAGGAA

1381 AATCTCAGTT GTTGTCTTCA AGGACCTTTC ATCTTCAGGA TTTACAGTGC ATTCTGAAAG
TTAGAGTCAA CAAACGAAGT TCCTGGAAAG TAGAAGTCCT AAATGTCACG TAAGACTTTC

1441 AGGAGACATC AAACAGAATT AGGAGTTGTG CAA
TCCTCTGTAG TTTGTCTTAA TCCTCAACAC GTT

```

*FIG. 10.* Predicted Full-length Polypeptide Sequence

1 MSLFGLLLLT SALAGQRQGT QAESNLSSKF QFSSNKEQYG VQDPQHERII  
51 TVSTNGSIHS PRFPHTYPRN TVLVWRLVAV EENVWQLTF DERFGLEDPE  
101 DDICKYDFVE VEEPSDGTIL GRWCGSGTVP GKQISKGNQI RIRFVSDEYF  
151 PSEPGFCIHY NIVMPQFTEA VSPSVLPESA LPDLLNNAI TAFSTLEDLI  
201 RYLEPERWQL DLEDLYRPTW QLLGKAFVFG RKSRVVDLNL LTEEVRLYSC  
251 TPRNFSVSIR EELKRTDTIF WPGCLLVKRC GGNCACCLHN CNECQCVPSK  
301 VTKKYHEVLQ LRPXTGVRGL HKSLTDVALE HHEECDCVCR GSTGG

16 / 54

*FIG. 11.* Alignment of VEGF-X with Other VEGFs

```

      *           20           *           40           *
VEGF_HUMAN : ----- : -
PLGF_HUMAN : ----- : -
VEGB_HUMAN : ----- : -
VEGC_HUMAN : ----- : -
VEGD_HUMAN : ----- : -
990126vegx : MSLFGLLLLTALAGQRQGTQAESNLSSKFQFSSNKEQNGVQDPQHERII : 50

      60           *           80           *           100
VEGF_HUMAN : ----- : -
PLGF_HUMAN : ----- : -
VEGB_HUMAN : ----- : -
VEGC_HUMAN : ----- : -
VEGD_HUMAN : ----- : -
990126vegx : TVSTNGSIHSPRFPHTYPRNTVLVWRLVAVEENVWVQLTFDERFGLEDPE : 100

      *           120           *           140           *
VEGF_HUMAN : ----- : -
PLGF_HUMAN : ----- : -
VEGB_HUMAN : ----- : -
VEGC_HUMAN : -----MHLLGFFSVACSLLAALLPGPREAPAAAA : 30
VEGD_HUMAN : -----MYREWVVVNV : 10
990126vegx : DDICKYDFVEV--EEPSDGTILGRWCGSGTVPGKQISKGNQIRIRFVSDE : 148

      160           *           180           *           200
VEGF_HUMAN : -----MN : 2
PLGF_HUMAN : -----MP : 2
VEGB_HUMAN : ----- : -
VEGC_HUMAN : AFESGLDLSDAEPDAGEATAYASKDLEEQLRSVSSVDELMTVLYPEYWKM : 80
VEGD_HUMAN : FMMLYVQLVQGSSNEHGPVKRSSQSTLERSEQQIRAASSLEELLRITHSE : 60
990126vegx : YFPSEPGFCIHYNIVMPQFTEAVSPSVLPPSALPLDLLNNAITAFSTLED : 198

      *           220           *           240           *
VEGF_HUMAN : FLLSWVHWSLALLLYLHHAKWSQAAPMAEGGGQNHHEVVVKFMD-VYQRSY : 51
PLGF_HUMAN : VMRLFPFCFLQLLAGLALPAVPPQQWALSAGNGSSEVEVVPFQE-VWGRSY : 51
VEGB_HUMAN : ---MSPLLRLRLLAALLQLAPAPVSPQDPAGHQKVVSWID-VYTRAT : 46
VEGC_HUMAN : YKCQLRKGGWQHNRQANLNSRTEETIKFAAAHYNTEILKSIDNEWRKTQ : 130
VEGD_HUMAN : DWKLWRCRLRLKSFTSMDSRASHRSTRFAATFYDIETLKVIDEEWORTQ : 110
990126vegx : LIRYLEPERWQLDLEDLYRPTWQLLGKAFVFGKRSRVVDLNLLEEVRLY : 248

      260           *           280           *           300
VEGF_HUMAN : CHPIETLVDFIQEYYPDEIEYIFKPSCVPLMRCGG---CCND--EGLECVP : 96
PLGF_HUMAN : CRALERLVDVVS EYPSEVEHMFSPSCVSLRCTG---CCGD--ENLHCVP : 96
VEGB_HUMAN : CQPREVVVPLTVELMGTVAKQLVPSCVTVQRCGG---CCPD--DGLECVP : 91
VEGC_HUMAN : CMPREVCIDVGKEFGVATNTFFKPPCVSVVRCGG---CCNS--EGLOCMN : 175
VEGD_HUMAN : CSPRETCVEVASELGKSTNTFFKPPCVNVFRCGG---CCNE--ESLICMN : 155
990126vegx : SCTPRNFSVSIREELKRTDTIFWEGCLLVKRCGGNCACCLHNCNECQCVP : 298

```

## FIG. 11 (CONTINUED).

VEGF_HUMAN	:	TEESNITMQLMRLKPHQG-----QHIGEMSFLOHMKCECRPKKDRARQEK	:	141
PLGF_HUMAN	:	VETANVTMQLLKIRSGDR-----PSYVELTFSQHVRCERPLREKMKPER	:	141
VEGB_HUMAN	:	TGQHQVRMQLLMIRYPS-----SQLGEMSLLEHHSQCECRPKKKDSAVKP	:	135
VEGC_HUMAN	:	TSTSYLSKTLFEITVPLSQG---PKPVTISFANHTSCRCMSKLDVYRQVH	:	222
VEGD_HUMAN	:	TSTSYISKQLFEISVPLTSV---PELVFVKVANHTGCKCLPTAPRHPYSI	:	202
990126vegx	:	SKVTKKYHEVLQLRPKTGVRGLHKS LTDVALEHFEEDCVCRGSTGG---	:	345
VEGF_HUMAN	:	KSVRGKGGQKRKRKKSRYKSWSVP-----	:	166
PLGF_HUMAN	:	-----	:	-
VEGB_HUMAN	:	DSPR-----	:	139
VEGC_HUMAN	:	SIIRSLPATLPQCAANKTCPTNYMWNHICRCLAQEDFMFSSDAGDDS	:	272
VEGD_HUMAN	:	IRRSIQIPEEDRCSHKKLCPIDMLWDSNKCKCVLQENPLAGT-----	:	246
990126vegx	:	-----	:	-
VEGF_HUMAN	:	-----	:	-
PLGF_HUMAN	:	-----	:	-
VEGB_HUMAN	:	-----	:	-
VEGC_HUMAN	:	TDGFHDICGPNKELDEETCQCVCRAGLRPASCGPHKELDRNSCQCVCKNK	:	322
VEGD_HUMAN	:	-----EDHSHLQEPALCGP	:	260
990126vegx	:	-----	:	-
VEGF_HUMAN	:	-----CGPCSERRKHLFVQDPQTCKC-SCKNTDSRCKARQLELNER	:	206
PLGF_HUMAN	:	-----CGDAVPRR-----	:	149
VEGB_HUMAN	:	-----PLCPRCTQHHQRPDPRTCRCRCRRRSFLRCQGRGLELNP	:	179
VEGC_HUMAN	:	LFPSQCGANREFDENTCQCVCCKRTCPRNQPLNPGKCAECTESPQKCLLK	:	372
VEGD_HUMAN	:	HMMFDEDRCECVCKTPCPKDLIQHPKNCSCFECKESLETCCQKHKLFPD	:	310
990126vegx	:	-----	:	-
VEGF_HUMAN	:	TCRCDKPRR-----	:	215
PLGF_HUMAN	:	-----	:	-
VEGB_HUMAN	:	TCRCRKLRR-----	:	188
VEGC_HUMAN	:	GKKFHHQTCSCYRRPCTNRQKACEPGFSYSEEVCRVCPSYWKRPQMS---	:	419
VEGD_HUMAN	:	TCSCEDRCPFHTRPCASGKTACAKHCRFPKEKRAAQGPHSRKNP-----	:	354
990126vegx	:	-----	:	-

*FIG. 12.*

## Variant Polypeptide Sequences

```

      *           20           *           40           *
FL_seq  : MSLFGLLLLTALAGQRQGTQAESNLSSKFQFSSNKEQNGVQDPQHERII : 50
clone41 : MSLFGLLLLTALAGQRQGTQAESNLSSKFQFSSNKEQNGVQDPQHERII : 50
clone20 : MSLFGLLLLTALAGQRQGTQAESNLSSKFQFSSNKEQNGVQDPQHERII : 50

      60           *           80           *           100
FL_seq  : TVSTNGSIHSPRFPHPTYPRNTVLVWRLVAVEENVWIQLTFDERFGLEDPE : 100
clone41 : TVSTNGSIHSPRFPHPTYPRNTVLVWRLVAVEENVWIQLTFDERFGLEDPE : 100
clone20 : TVSTNGSIHSPRFPHPTYPRNTVLVWRLVAVEENVWIQLTFDERFGLEDPE : 100

      *           120           *           140           *
FL_seq  : DDICKYDFVEVEEPSDGTILGRWCGSGTVPGKQISKGNQIRIRFVSDEYF : 150
clone41 : DDICKYDFVEVEEPSDGTILGRWCGSGTVPGKQISKGNQIRIRFVSDEYF : 150
clone20 : DDICKYDFVEVEEPSDGTILGRWCGSGTVPGKQISKGNQIRIRFVSDEYF : 150

      160           *           180           *           200
FL_seq  : PSEP GFCIHYNI VMPQFTEAVSPSVLPPSALPLDLLNNAITAFSTLEDLI : 200
clone41 : PSEP SNRGGKI IQLHTS----- : 167
clone20 : PSEP GFCIHYNI VMPQFTEAVSPSVLPPSALPLDLLNNAITAFSTLEDLI : 200

      *           220           *           240           *
FL_seq  : RYLEPERWQLDLEDLYRPTWQLLGKAFVFGRKSRVVDLNLNLTTEEVRLYSC : 250
clone41 : ----- : -
clone20 : RYLEPERWQLDLEDLYRPTWQLLGKAFVFGRKSRVVDLNLNLT----- : 243

      260           *           280           *           300
FL_seq  : TPRNFSVSIREELEKRTDTIFWPGCLLVKRCGGNCACCLHNCNECQCVP SK : 300
clone41 : ----- : -
clone20 : ----- : -

      *           320           *           340
FL_seq  : VTKKYHEVLQLRPKTGVRGLHKS LTDVALEHHEECDVCVRGSTGG : 345
clone41 : ----- : -
clone20 : -----EVLQLRPKTGVRGLHKS LTDVALEHHEECDVCVRGSTGG : 282

```

*FIG. 13.* Primers for Expression of VEGF-X*E.coli expression of domain-*

vegX-6	AATTGGATCCGAGAGTGGTGGATCTGAACC
vegX-7	AATTGGATCCGGGAAGAAAATCCAGAGTGG
vegX-8	GGTTGAATTCATTATTTTTTAGTAACTTTGCTTGGGACAC
vegX-9	AATTGAATTCATTATCCTCCTGTGCTCCCTC

*Baculovirus/insect cell expression of full-length protein-*

vegbac1	AATTGGATCCGGAGTCTCACCATCACCACCATCATGAATCCAACCTGAGTAGTAAATTC C
vegbac2	AATTGAATTCGCTATCCTCCTGTGCTCCCTCTGC

*FIG. 14.*

>3993180H1 LUNGNON03 INCYTE  
CACAAATCACTCACCGACGTGGCCCTGGAGCACCATGAGNGTGTGACTGTGTGTGCAGAGGGAGCACAGGAGGATAGCC  
GCATCACCACCAGCAGCTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCAT  
CCTTAATCTCAGTTGTTTGTCTCAAGGACCTTTCATCTTCAGGATTTACAGTGCATTCTGAAAGAGGAGACATCAAACAG  
AATTAGGAGTTGTGCAACAGCTCTTTTGAGAGGAGGCTAAAGGACAGGAGAAAGGTCCTT

>3510192H1 CONCN01 INCYTE  
TGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCATCCTTAATCTCAGTTGTTTGTCTCAAGGACCTT  
TCATCTTCAGGATTTACAGTGCATTCTGAAAGAGGAGACATCAAACAGAATTAGGAGTTGTGCAACAGCTCTTTTGAGAG  
GAGGCTTAAAGGACAGGAGAAAAGGCTTCAATCTGTGAAAGAAAATTAAATGTTGTATTAAATAGATCACCAGCTAGTT  
TCAGAGTTACCATGTACGTATCCACTAGCTGGGTTCTGTATT

>2559870H1 ADRETUT01 INCYTE  
CAGGAGTCTTTCAGTTGAGACCAAGACCGGTGTGAGGGATTGCACAAATCACTCACCGACGTGGCCCTGGAGCACCA  
TGAGGAGTGTGACTGTGTGTGCAGAGGGAGCACAGGGGATAGCCGCATCACCACCAGCAGCTCTTGCCAGAGCTGTGC  
AGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCATCCTTAATCTCAGTTGTTTGTCTCAAGGACCTTTCA  
TCTTCAGGATTTACAGTGCATTCTGAAAGAGGAGA

>3979767H1 LUNGTUT08 INCYTE  
GGAGGATAGCCGCATCACCACCAGCAGCTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGC  
GTTATCTCCATCCTTAATCTCAGTTGTTTGTCTCAAGGACCTTTCATCTTCAGGATTTACAGTGCATTCTGAAAGAGGAG  
ACATCAAACAGAATTAGGAGTTGTGCAACAGCTCTTTTGAGAGGAGGCTAAAGGACAGGAGAAAAGGCTTCAATCGTG  
GAAAGAAATTAATGTTGTATTAAATAGACACCAGCT

>3980011H1 LUNGTUT08 INCYTE  
GGAGGATAGCCGCATCACCACCAGCAGCTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGC  
GTTATCTCCATCCTTAATCTCAGTTGTTTGTCTCAAGGACCTTTCATCTTCAGGATTTACATGCATTCTGAAAGAGGAGA  
CATCAAACAGAATTAGGAGTTGTGCAACAGCTCTTTTGAGAGGAGGCTAAAGGACAGGAGAAAAGGCTTCAATCGTG  
AAAGAAAATTAATGTTGTATTAAATAGATCACCA

>4825396H1 BLADDIT01 INCYTE  
GAGAACCAGTACCATTTCTGGCCAGGTTGTCTCCTGGTTAAACGCTGTGGTGGGAAGTGTGCCTGTTGTCTCCACAATT  
GCAATGAATGTCAATGTGTCCCAAGCAAAGTTACTAAAAAATACCACGAGGTCTTCAGTTGAGACCAAAGACCGGTGTG  
AGGGGATTGCACAAATCACTCACCGACGTGGCCCTGGAGCACCATGAGGAGTGTGACTGTGTGTGCAGAGGGAGCACAGG  
AGGATAGCCGCATCACCACCA

>3073703H1 BONEUNT01 INCYTE  
AGAAAATCCAGAGTGGTGGATCTGAACCTTCTAACAGAGGAGGTAAGATTATACAGCTGCACACCTCGTAACTTCTCAGT  
GTCCATAAGGGAAGAACTAAAGAGAACCGATACCATTTCTGGCCAGGTTGTCTCCTGGTTAAACGCTGTGGTGGGAAGT  
GTGCTGTGTCTCCACAATTGCAATGAATGTCAATGTGTCCCAAGCAAAGTTACTAAAAAATACCACGAGGTCTTCAG  
TTGAGACCAAAGACCGGTGTGAGGGATTGCACAAATCA

>1302516H1 PLACNOT02 INCYTE  
AGGAAATCAAATTAGGATAAGATTGTATCTGATGAATATTTTCTTCTGAACCTTCTAACAGAGGAGGTAAGATTATAC  
AGCTGCACACCTCGTAACCTTCTCAGTGTCCATAAGGGAAGAACTAAAGAGAACCGATACCATTTTCTGGCCAGGTTGTCT  
CCTGGTTAAACGCTGTGGTGGGAAGTGTGCCTGTGTCTCCACAATTGCAATGAATGTCAATGTGTCCCAAGCAAAGTT  
ACTAAAAAATACCACGAGGTCC

>3684109H1 HEAANOT01 INCYTE  
ATTTTCATCTTCAGGATTTACAGTGCATTCTGAAANAGGAGAAATCAAACANAATTAGGAGTTGTGCAACAGCTCTTTTGA  
GAGGAGGCTTAAAGGACAGGAGAAAAGGCTTCAATCGTGGAAANAAAATTAAATGTTGTATTAAATAGATCACCAGCTA  
GTTTCAGAGTTACCATGTACGTATTCCACTAGCTGGGTTCTGTATTTCAGTCTTTTCGATACGGCTTAGGGTAATGTGAG  
TACAGGAAAAAACTGTGCAAGTGAACCTGATTCCGTTGCCTTGCTT

>4713188H1 BRAIHCT01 INCYTE  
CAAAGTTACTAAAAAATACCACGAGGTCTTCAGTTGAGACCAAAGACCGGTGTGAGGGGATTGCACAAATCACTCACCG  
ACGTGGCCCTGGAGCACCATGAGGAGTGTGACTGTGTGTGCAGAGGGAGCACAGGAGGATAGCCGCATCACCACCAGCAG  
CTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCATCCTTAATCTCAGTTGT  
TTGCT

>458823H1 KERANOT01 INCYTE  
ANGAGTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCATCCTTAATCTCAGTT  
GTTTGNNTCAAGGACCTTTCATCTTCAGGATTTACAGTGCATTCTGAAAGAGGAGACATCAAACAGAATTAGGAGTTGTG  
CAACAGCTCTTTTGAGAGGAGGCTTAAAGGNCAGGAGAAAAGGCTTCAATCGTGGAAAGAAAATTAAATGTTGTATTAA  
ATAGATC

>1303909H1 PLACNOT02 INCYTE  
AGGAAATCAAATTAGGATAAGATTGTATCTGATGAATATTTTCTTCTGAACCTTCTAACAGAGGAGGTAAGATTATAC  
AGCTGCACACCTCGTAACCTTCTCAGTGTCCATAAGGGAAGAACTAAAGAGAACCGATACCATTTTCTGGCCAGGTTGTCT  
CCTGGTTAAACGCTGTGGTGGGAAGTGTGCCTGTGTCTCCACAATTGCAATGAATGTCAATGTGTCCCAAG



*FIG. 14 (CONTINUED).*

>2739211H1 OVARNOT09 INCYTE  
GTGCATTCTGAAAGAGGAGACATCAAACAGAATTAGGAGTTGTGCAACAGCTCTTTTGAGAGGAGGCCTAAAGGACAGGA  
GAAAAGGTCTTCAATCGTGAAAGAAAATTAAATGTTGTATTAAATAGATCACCAGCTAGTTTCAGAGTTACCATGTACG  
TATTCCACTAGCTGGGTTCTGTATTTTCAGTTCTTTTCGATACGGCTTAGGGTAATGTCAGTACAGGAAAAAACTGTGCAA  
GTGAGCACCTGAT

>3325591H1 PTHYNOT03 INCYTE  
TGCAACAGCTCTTTTGAGAGGAGGCCTAAAGGACAGGAGAAAAGGTCTTCAATCGTGAAAGAAAATTAAATGTTGTATT  
AAATAGATCACCAGCTAGTTTCAGAGTTACCATGTACGTATTCCACTAGCTGGGTTCTGTATTTTCAGTTCTTTTCGATACG  
GCTTAGGGTAATGTCAGTACAGGAAAAAACTGTGCAAGTGAGCACCTGATTCCGTTGCCTTGCTTAACCTAAAGCNCC  
ATGTCNNGGGCNAANAACGAAAAAT

>3733565H1 SMCCNOS01 INCYTE  
CCTTAATCTCAGTTGTTTGCTTCAAGGACCTTTCATCTTCAGGATTTACAGTGCATTCTGNAAGANGAGACATCAAACAG  
AATTAGGNGTTGTGCAAAAGCTCTTTTGAGAGGAGGCCTAAAGGACAGGAGAAAAGGTCTNCAATCGTGAAAGNAAATT  
AAATGTTGTATNAAATNGATCACCAGCTAGTTTCAGAGTTACCATGTACGTATTCCACTAGCTGGGNCNGTATTTCAGTCT  
TTCGGAACGGCTTAGGGTAATGTCAGTACAGGANAAAACTGTGCAGTGAG

>3554223H1 SYNONOT01 INCYTE  
ATTAAATAGATCACCAGCTAGTTTCAGAGTTACCATGTACGTATTCCACTAGCTGGGTTCTGTATTTTCAGTTCTTTTCGAT  
ACGGCTTAGGGTAATGTCAGTACAGGAAAAAACTGTGCAAGTGAGCACCTGATTCCGTTGCCTTGCTTAACTCTAAAG  
CTCCATGTCTCGGCCCTAAAATCGTATAAAATCTGGATTTTTTTNTTTTTTTTTTGCGCATATTACATATGTAAACCAGN  
ACATTCTATGTACNACAAACCTGGTTTTTTAAAAGGAAC

>4507477H1 OVARTD01 INCYTE  
GGCTAGTTTCAGAGTTACCATGTACGTATTCCACTAGCTGGGTTCTGTATTTTCAGTTCTTTTCGATACGGCTTAGGGTAAT  
GTCAGTACAGGAAAAAACTGTGCAAGTGAGCACCTGATTCCGTTGCCTTGCTTAACTCTAAAGCTCCATGTCCTGGGCC  
TAAAATCGTATAAAATCTGGA

>4163378H1 BRSTNOT32 INCYTE  
AATAGATCACCAGCTAGTTTCAGAGTTACCATGTACGTATTCCACTAGCTGGGNTCTGTATTTTCAGTTCTTTTCGATACG  
GCTTAGGGTAATGTCAGTACAGGAAAAAGCTGTGCAAGTGAGCACCTGATTCCGTTGCCTTGCTTAACTCTAAAGCTCC  
ATGTCCTGGGCCCTAAAATCGTATA

*FIG. 15.*

>2054675H1 BEPINOT01 INCYTE  
AAAGGAACCTATGTTGCTATGAATTAACTTGTGTCGTGCTGATAGGACAGACTGGATTTTTCATATTTCTTATTAAATTT  
TCTGCCATTTAGAGAAGAGAACTACATTCATGGTTTGGAGAGATAAACCTGAAAAGAAGAGTGGCCTTATCTTCACTT  
TATCGATAAGTCAGTTTATTTGTTTCATTGTGTACATTTTATATTCTCCTTTTGACATTATAACTGTTGGCTTTTCTAA  
TCTTGTAAATATATCTATTTTACCAGGATTTTAATATTCTTTTTTA  
>3993180H1 LUNGNON03 INCYTE  
CACAAATCACTCACCGACGTGGCCCTGGAGCACCATGAGGNGTGTGACTGTGTGTGCAGAGGGAGCACAGGAGGATAGCC  
GCATCACCACCAGCAGCTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCAT  
CCTTAATCTCAGTTGTTTGCCTTCAAGGACCTTTTCATCTTCAGGATTTACAGTGCATTCTGAAAAGAGGAGACATCAAACAG  
AATTAGGAGTTGTGCAACAGCTCTTTTGAGAGGAGGCTAAAGGACAGGAGAAAGGTCTT  
>3510192H1 CONCNOT01 INCYTE  
TGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCATCCTTAATCTCAGTTGTTTGCCTTCAAGGACCTT  
TCATCTTCAGGATTTACAGTGCATTCTGAAAGAGGAGACATCAAACAGAATTAGGAGTTGTGCAACAGCTCTTTTGAGAG  
GAGGCTTAAAGGACAGGAGAAAAGGTCTTCAATCGTGAAAGAAAATTAATGTTGTATTAAATAGATCACCAGCTAGTT  
TCAGAGTTACCATGTACGTATTCCACTAGCTGGGTTCTGTATTT  
>4164633H1 BRSTNOT32 INCYTE  
CTTGTTAAATATATCTATTTTACCAGGATTTTAATATTCTTTANTTATGACAACTTAGATCAACTATTTTGTAGCTTG  
GTAAATTTTCTAAACACAATTGTTATAGCCAGAGGAACAAAGATGATATAAAATATTGTTGCTCTGACAAAATACATG  
TATTTTCATTCTCGTATGGTGTAGAGTTAGATTAATCTGCATTTTAAAAAACTGAATTGGAATAGAATTGGTAAGTTGCA  
AAGACTTTTGTANAATAATTAATATCATATCTTCCATTCTGTTATTGGGGGAGAAAAT  
>2559870H1 ADRETUT01 INCYTE  
CACGAGGTCTTTCAGTTGAGACCAAAGACCGGTGTGAGGGGATTGCACAAATCACTCACCGACGTGGCCCTGGAGCACCA  
TGAGGAGTGTGACTGTGTGTGCAGAGGGAGCACAGGGGATAGCCGCATCACCACCAGCAGCTCTTGCCAGAGCTGTGC  
AGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCATCCTTAATCTCAGTTGTTTGCCTTCAAGGACCTTTCA  
TCTTCAGGATTTACAGTGCATTCTGAAAGAGGAGA  
>3817470H1 BONSTUT01 INCYTE  
TTAAAAAGGAACCTATGTTGCTATGAATTAACTTGTGTCATGCTGATAGGACAGACTGGATTTTTCATATTTCTTATTAA  
AATTTCTGCCATTTAGAGAAGAGAACTACATTCATGGTTTGGAGAGATAAACCTGAAAAGAAGAGTGGCCTTATCTTC  
ACTTTATCGATAAGTCAGTTTATTTGTTTCATTGTGTACATTTTATATTCTCCTTTTGACATTATAACTGTTGGCTTTC  
TAATCTGTAAATATATCTATTTTACCAGGATTTTAATATTCTTT  
>3979767H1 LUNGTUT08 INCYTE  
GGAGGATAGCCGCATCACCACCAGCAGCTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGC  
GTTATCTCCATCCTTAATCTCAGTTGTTTGCCTTCAAGGACCTTTTCATCTTCAGGATTTACAGTGCATTCTGAAAGAGGAG  
ACATCAAACAGAATTAGGAGTTGTGCAACAGCTCTTTTGAGAGGAGGCTTAAAGGACAGGAGAAAAGGTCTTCAATCGTG  
GAAAGAAATTAATGTTGTATTAAATAGACACCAGCT  
>3980011H1 LUNGTUT08 INCYTE  
GGAGGATAGCCGCATCACCACCAGCAGCTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGC  
GTTATCTCCATCCTTAATCTCAGTTGTTTGCCTTCAAGGACCTTTTCATCTTCAGGATTTACATGCATTCTGAAAGAGGAGA  
CATCAAACAGAATTAGGAGTTGTGCAACAGCTCTTTTGAGAGGAGGCTTAAAGGACAGGAGAAAAGGTCTTCAATCGTGG  
AAAGAAAATTAATGTTGTATTAAATAGATCACCA  
>4825396H1 BLADDIT01 INCYTE  
GAGAACCAGATACCATTTCTGGCCAGGTTGTCTCCTGGTTAAACGCTGTGGTGGGAACCTGTGCCTGTTGTCTCCACAATT  
GCAATGAATGTCAATGTGTCCCAAGCAAAGTTACTAAAAAATACCACGAGGTCTTTCAGTTGAGACCAAAGACCGGTGTG  
AGGGGATTCACAAATCACTCACCGACGTGGCCCTGGAGCACCATGAGGAGTGTGACTGTGTGTGCAGAGGGAGCACAGG  
AGGATAGCCGCATCACCACCA  
>3073703H1 BONEUNT01 INCYTE  
AGAAAATCCAGAGTGGTGGATCTGAACCTTCTAACAGAGGAGGTAAGATTATACAGCTGCACACCTCGTAACTTCTCAGT  
GTCCATAAGGGAAGAACTAAAGAGAACCGATACCATTTTCTGGCCAGGTTGTCTCCTGGTTAAACGCTGTGGTGGGAACCT  
GTGCTGTGTCTCCACAATTGCAATGAATGTCAATGTGTGCCAAGCAAAGTTACTAAAAAATACCACGAGGTCTTTCAG  
TTGAGACCAAAGACCGGTGTGAGGGGATTGCACAAATCA  
>862169H1 BRAITUT03 INCYTE  
AGATGATATAAAATATTTGCTCTGACAAAAATACATGTATTTCATTCTCGTATGGTGTAGAGTTAGATTAAATCTGCA  
TTTTAAAAAACTGAATTGGAATAGAATTGGTAAGTTGCAAAGACTTTTTGAAAATAATTAAATTATCATATCTTCCATTC  
CTGTTATTGGAGATGAAAATAAAAGCAACTTATGAAAGTAGACATTCAGATCCAGCCATTACTAACCTATTCCTTTTTT  
GGGGAATCTGAGCCTAGC  
>4201385H1 BRAITUT29 INCYTE  
TTTTTAAAAAGGAACCTATGTTGCTATGAATTAACTTGTGTCGTGCTGATAGGACAGACTGGATTTTTCATATTTCTTAT  
TAAAAATTTCTGCCATTTAGAGAAGAGAACTACATTCATGGTTTGGAGAGATAAACCTGAAAAGAAGAGTGGCCTATCT  
TCACTTTATCGATAAGTCAGTTTATTTGTTTCATTGTGTACATTTTATATTCTCCTTTTGACATATAACTGTTGGCTTTT

*FIG. 15 (CONTINUED 1).*

CTAATCTGTAAATATATCTATTTTTACCAAAGGTATTTAATAT  
>1302516H1 PLACNOT02 INCYTE  
AGGAAATCAAATTAGGATAAGATTTGTATCTGATGAATATTTTCCTTCTGAACCTTCTAACAGAGGAGGTAAGATTATAC  
AGCTGCACACCTCGTAACTTCTCAGTGTCCATAAGGGAAGAACTAAAGAGAACCGATAACCATTTTTCTGGCCAGGTTGTCT  
CCTGGTTAAACGCTGTGGTGGGAACCTGTGCCTGTTGTCTCCCAATTGCAATGAATGTCAATGTGTCCCAAGCAAAGTT  
ACTAAAAAATACCACGAGGTCC  
>3684109H1 HEAANOT01 INCYTE  
ATTTTCATCTTCAGGATTTACAGTGCATTCTGAAANAGGAGAAATCAAACANAATTAGGAGTTGTGCAACAGCTCTTTTGA  
GAGGAGGCCTAAAGGACAGGAGAAAAGGCTTCAATCGTGGAANAAAAATTAATGTTGTATTAAATAGATCACCAGCTA  
GTTTCAGAGTTACCATGTACGTATTTCCACTAGCTGGGTTCTGTATTTTCAGTTCTTTTCGATACGGCTTAGGGTAATGTCAG  
TACAGGAAAAAACTGTGCAAGTGAGCACCTGATTCCGTTGCCTTGCTT  
>2549720H1 LUNGUT06 INCYTE  
TTAGCTTGGNAAATTTTTCTAAACACAATTGTTATAGCCAGAGGAACAAAGATGATATAAAATATTGTTGCTCTGACAAA  
AATACATGTATTTTCATTCTCGTATGGTGCTAGAGTTAGATTAATCTGCATTTTAAAAAAGTGAATTGGAATAGAATTGGT  
AAGTTGCAAAGACTTTTTGAAAATAATTAATATCATATCTTCCATTCTGTTATTGGAGATGAAAATAAAAAGCAACT  
TATGANAGTAG  
>877279H1 LUNGAST01 INCYTE  
CTTTTTTATGACAACTTAGATCAACTATTTTTAGCTTGGTAAATTTTTCTAAACACAATTGTTATAGCCAGAGGAACAAA  
GATGATATAAAATATTGTTGCTCTGACAAAAATACATGTATTTTCATTCTCGTATGGTGCTAGAGTTAGATTAATCTGCAT  
TTTTAAAAAAGTGAATTGGAATAGAATTGGTAAGTTGCAAAGGCTTTTTGAAAATAATTAATATCATATCTTCCATTCC  
TGTTATTGGNGG  
>4713188H1 BRAIHCT01 INCYTE  
CAAAGTTACTAAAAAATACCACGAGGTCCCTTCAGTTGAGACCAAAGACCGGTGTGAGGGGATTGCACAAATCACTCACCG  
ACGTGGCCCTGGAGCACCATGAGGAGTGTGACTGTGTGTGAGAGGGAGCACAGGAGGATAGCCGCATCACCACCAGCAG  
CTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCATCCTTAATCTCAGTTGT  
TTGCT  
>2171082H1 ENDCNOT03 INCYTE  
AGATAAACCTGAAAAGAAGAGTGGCCTTATCTTCACTTTATCGATAAGTCAGTTTATTTGTTTCATTGTGTACATTTTTTA  
TATTCTCCTTTTGACATTATAACTGTTGGCTTTTCTAATCTTGTAAATATATCTATTTTTTACCAAAGGTATTTAATATT  
CTTTTTTATGACAACTTAGATCAACTATTTTTAGCTTGGTAAATTTTTCTAAACACAATTGTTATAGCCAGAGGAACAAA  
GATGA  
>875860H1 LUNGAST01 INCYTE  
CTGGATTTTTCATATTTCTTATTAAAAATTTCTGCCATTTAGAAGAAGAGAACTACATTCATGGTTTGGAAAGAGATAAAC  
TGAAAAGAAGAGTGGCCTTATCTTCACTTTATCGATAAGTCAGTTTATTTGTTTCATTGTGTACATTTTATATTCTCCT  
TTTGACATTATAACTGTTGGCTTTTCTAATCTTGTAAATATATCTATTTTTTACCAAAGGTATTTAATATTCTTTTTTAT  
GAC  
>706168H1 SYNORAT04 INCYTE  
GTCATATTCACATATGTAAACCAGAACTTCTATGTACTACAAACCTGGTTTTTAAAAAGGANCTATGTTGCTATGAAT  
TAACTTGTGTCGTGCTGATAGGACAGACTGGATTTTTCATATTTCTTATTAAAAATTTCTGCCATTTAGAAGAAGAGAAC  
TACATTCATGGTTTGGAAAGAGATAAACCTGAAAAGAAGAGTGGCCTTATCTTCANTTTATCGATAAGTCAGTTTATTTGT  
TTCA  
>458823H1 KERANOT01 INCYTE  
ANGAGTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCATCCTTAATCTCAGTT  
GTTTGNNTCAAGGACCTTTCATCTTCAGGATTTACAGTGCATTCTGAAAGAGGAGACATCAAACAGAATTAGGAGTTGTG  
CAACAGCTCTTTTGAGAGGAGGCCATAAGGNCAGGAGAAAAGGTCTTCAATCGTGGAAAGAAAATTAATGTTGTATTAA  
ATAGATC  
>538436H1 LNODNOT02 INCYTE  
AAAGATGATATAAAATATTGTTGCTCTGACAAAAATACATGTATTTTCATTCTCGTATGGTGCTAGAGTTAGATTAATCTG  
CATTTTTAAAAAAGTGAATTGGAATAGAATTGGTAAGTTGCAAAGACTTTTTGAAAATAATTAATATCATATCTTCCAT  
TCCTGTTATTGGAGATGAAAATAAAAAAGCAACTTATGAAAGTAGACATTCAGATCCAGCCATTACTAACCTAT  
>1303909H1 PLACNOT02 INCYTE  
AGGAAATCAAATTAGGATAAGATTTGTATCTGATGAATATTTTCCTTCTGAACCTTCTAACAGAGGAGGTAAGATTATAC  
AGCTGCACACCTCGTAACTTCTCAGTGTCCATAAGGGAAGAACTAAAGAGAACCGATAACCATTTTCTGGCCAGGTTGTCT  
CCTGGTTAAACGCTGTGGTGGGAACCTGTGCCTGTTGTCTCCACAATTGCAATGAATGTCAATGTGTCCCAAG  
>2739211H1 OVARNOT09 INCYTE  
GTGCATTCTGAAAGAGGAGACATCAAACAGAAATTAGGAGTTGTGCAACAGCTCTTTTGAGAGGAGGCCATAAGGACAGGA  
GAAAAGGCTTCAATCGTGGAAAGAAAATTAATGTTGTATTAAATAGATCACCAGCTAGTTTCAGAGTTACCATGTACG  
TATTCACCTAGCTGGGTTCTGTATTTTCAGTTCTTTTCGATACGGCTTAGGGTAATGTCAGTACAGGAAAAAACTGTGCAA  
GTGAGCACCTGAT

**SUBSTITUTE SHEET (RULE 26)**

**SUBSTITUTE SHEET (RULE 26)**

*FIG. 16.*

VEGFE1	AAAATGTATGGATACAACTTAC	22
VEGFE2	GTTTGATGAAAGATTTGGGCTTG	23
VEGFE3	TTTCTAAAGGAAATCAAATTAG	22
VEGFE4	GATAAGATTTGTATCTGATG	20
VEGFE5	GATGTCTCCTCTTTCAG	17
VEGFE6	GCACAACTCCTAATTCTG	18
VEGFE7	AGCACCTGATTCCGTTGC	19
VEGFE8	TAGTACATAGAATGTTCTGG	20
VEGFE9	AAGAGACATACTTCTGTAC	19
VEGFE10	CCAGGTACAATAAGTGAAGTGA	21

27 / 54

FIG. 17.

```

      +3
N L L T E E V R L Y
      ]-----

1 AGGAAATCAA ATTAGGATAA GATTGTATC TGATGAATAT TTTCCTTCTG
AACCTTCTAA CAGAGGAGGT AAGATTATAC
TCCTTTAGTT TAATCCTATT CTAAACATAG ACTACTTATA AAAGGAAGAC
TTGGAAGATT GTCTCCTCCA TTCTAATATG

      +3 S C T P R N F S V S I R E E L K R
T D T I F W P G C L
      ]-----

81 AGCTGCACAC CTCGTAAC TTCTCAGTGTCC ATAAGGGAAG AACTAAAGAG
AACCGATACC ATTTTCTGGC CAGGTTGTCT
TCGACGTGTG GAGCATTGAA GAGTCACAGG TATTCCCTTC TTGATTTCCTC
TTGGCTATGG TAAAAGACCG GTCCAACAGA
      -2
      <-----

      +3 L V K R C G G N C A C C L H N C N
E C Q C V P S K V
      ]-----

161 CCTGGTTAAA CGCTGTGGTG GGAAGTGTGC CTGTTGTCTC CACAATTGCA
ATGAATGTCA ATGTGTCCCA AGCAAAGTTA
GGACCAATTT GCGACACCAC CCTTGACACG GACAACAGAG GTGTTAACGT
TACTTACAGT TACACAGGGT TCGTTTCAAT
      -2
      ]-----

      +3 T K K Y H E V L Q L R P K T G V R
G L H K S L T D V A
      ]-----

      +1
D C T N H S P T W P
      ]-----

241 CTAAAAAATA CCACGAGGTC CTTCAGTTGA GACCAAAGAC CGGTGTCAGG
GGATTGCACA AATCACTCAC CGACGTGGCC
GATTTTTTAT GGTGCTCCAG GAAGTCAACT CTGGTTTCTG GCCACAGTCC
CCTAACGTGT TTAGTGAGTG GCTGCACCGG
      -2
      [

      +3 L E H H E E C D C V C R G S T G G

```

## FIG. 17 (CONTINUED).

```

>
      +2      V   Q   R   E   H   R   R
I   A   A   S   P   P   A   A   L   A
      ]-----
-----
      +1      W   S   T   M   R   S   V   T   V   C   A   E   G   A   Q   E   D
S   R   I   T   T   S   S   S   C
-----
-----
321  CTGGAGCACC ATGAGGAGTG TGA CTGTGTG TGCAGAGGGA GCACAGGAGG
     ATAGCCGCAT CACCACCAGC AGCTCTTGCC
           GACCTCGTGG TACTCCTCAC ACTGACACAC ACGTCTCCCT CGTGTCCTCC
TATCGGCGTA GTGGTGGTCG TCGAGAACGG
-----
      +2      Q   S   C   A   V   Q   W   L   I   L   L   E   N   V   C   V   I
S   I   L   N   L   S   C   L   L   Q
-----
-----
      +1      P   E   L   C   S   A   V   A   D   S   I   R   E   R   M   R   Y
L   H   P
-----
----->
401  CAGAGCTGTG CAGTGCAGTG GCTGATTCTA TTAGAGAACG TATGCGTTAT
     CTCCATCCTT AATCTCAGTT GTTTGCTTCA
           GTCTCGACAC GTCACGTCAC CGACTAAGAT AATCTCTTGC ATACGCAATA
GAGGTAGGAA TTAGAGTCAA CAAACGAAGT
-----
      +2      G   P   F   I   F   R   I   Y   S   A   F
----->
481  AGGACCTTTC ATCTTCAGGA TTTACAGTGC ATTCTGAAAG AGGAGACATC
     AAACAGAATT AGGAGTTGTG CAACAGCTCT
           TCCTGGAAAG TAGAAGTCCT AAATGTCACG TAAGACTTTC TCCTCTGTAG
TTTGTCTTAA TCCTCAACAC GTTGTGCGAGA
-----
561  TTTGAGAGGA GGCCTAAAGG ACAGGAGAAA AGGTCTTCAA TCGTGGAAG
     AAAATTAAAT GTTGATTAA ATAGATCACC
           AAACCTCTCCT CCGGATTTCC TGTCCTCTTT TCCAGAAGTT AGCACCTTTC
TTTTAATTTA CAACATAATT TATCTAGTGG
-----
641  AGCTAGTTTC AGAGTTACCA TGTACGTATT CCACTAGCTG GGTTCGTGAT
     TTCAGTTCTT TCGATACGGC TTAGGGTAAT
           TCGATCAAAG TCTCAATGGT ACATGCATAA GGTGATCGAC CCAAGACATA
AAGTCAAGAA AGCTATGCCG AATCCCATTA
-----
721  GTCAGTACAG GAAAAAACT GTGCAAGTGA GCACCTGATT CCGTTGCCTT
     GGCTTAACTC TAAAGCTCCA TGTCCTGGGC
           CAGTCATGTC CTTTTTTTGA CACGTTCACT CGTGGACTAA GGCAACGGAA
CCGAATTGAG ATTTGAGGT ACAGGACCCG
-----
801  CTAAAATCGT ATAAAATCTG GA
     GATTTTAGCA TATTTTAGAC CT

```



*FIG. 18.*

<sup>+3</sup>  
 N L L T E E V R L Y M N I F L L  
 ]-----  
 -----  
 1 AGGAAATCAA ATTAGGATAA GATTGTATC TGATGAATAT TTTCCTTCTG  
 AACCTTCTAA CAGAGGAGGT AAGATTATAC  
 TCCTTTAGTT TAATCCTATT CTAAACATAG ACTACTTATA AAAGGAAGAC  
 TTGGAAGATT GTCTCCTCCA TTCTAATATG  
<sup>+3</sup> S C T P R N F S V S I R E E L K R  
 T D T I F W P G C L  
 -----  
 -----  
 81 AGCTGCACAC CTCGTAACCTT CTCAGTGTCC ATAAGGGAAG AACTAAAGAG  
 AACCGATACC ATTTTCTGGC CAGGTTGTCT  
 TCGACGTGTG GAGCATTGAA GAGTCACAGG TATTCCTTC TTGATTCTC  
 TTGGCTATGG TAAAAGACCG GTCCAACAGA  
 -2 <-----  
 -----  
<sup>+3</sup> L V K R C G G N C A C C L H N C N  
 E C Q C V P S K V  
 -----  
 -----  
 161 CCTGGTTAAA CGCTGTGGTG GGAAGTGTGC CTGTTGTCTC CACAATTGCA  
 ATGAATGTCA ATGTGTCCCA AGCAAAGTTA  
 GGACCAATTT GCGACACCAC CCTTGACACG GACAACAGAG GTGTTAACGT  
 TACTTACAGT TACACAGGGT TCGTTTCAAT  
 -2 -----  
 -----  
<sup>+3</sup> T K K Y H E V L Q L R P K T G V R  
 G L H K S L T D V A  
 -----  
 -----  
<sup>+1</sup> V S G  
 D C T N H S P T W P  
 ]-----  
 -----  
 241 CTAAAAAATA CCACGAGGTC CTTCAAGTTGA GACCAAAGAC CGGTGTCAGG  
 GGATTGCACA AATCACTCAC CGACGTGGCC  
 GATTTTTTAT GGTGCTCCAG GAAGTCAACT CTGGTTTCTG GCCACAGTCC  
 CCTAACGTGT TTAGTGAGTG GCTGCACCGG

## FIG. 18 (CONTINUED 1).

```

-2 -----
-----[
+3 L E H H E E C D C V C R G S T G G
>
+2 V Q R E H R R
I A A S P P A A L A
]-----
+1 W S T M R S V T V C A E G A Q E D
S R I T T S S S C
-----
321 CTGGAGCACC ATGAGGAGTG TGACTGTGTG TGCAGAGGGA GCACAGGAGG
ATAGCCGCAT CACCACCAGC AGCTCTTGCC
GACCTCGTGG TACTCCTCAC ACTGACACAC ACGTCTCCCT CGTGTCTCTC
TATCGGCGTA GTGGTGGTCG TCGAGAACGG
+2 Q S C A V Q W L I L L E N V C V I
S I L N L S C L L Q
-----
+1 P E L C S A V A D S I R E R M R Y
L H P
----->
401 CAGAGCTGTG CAGTGCAGTG GCTGATTCTA TTAGAGAACG TATGCGTTAT
CTCCATCCTT AATCTCAGTT GTTTGCTTCA
GTCTCGACAC GTCACGTCAC CGACTAAGAT AATCTCTTGC ATACGCAATA
GAGGTAGGAA TTAGAGTCAA CAAACGAAGT
+2 G P F I F R I Y S A F
----->
481 AGGACCTTTC ATCTTCAGGA TTTACAGTGC ATTCTGAAAG AGGAGACATC
AAACAGAATT AGGAGTTGTG CAACAGCTCT
TCCTGGAAAG TAGAAGTCCT AAATGTCACG TAAGACTTTC TCCTCTGTAG
TTTGTCTTAA TCCTCAACAC GTTGTGCGAGA
561 TTTGAGAGGA GGCCTAAAGG ACAGGAGAAA AGGTCTTCAA TCGTGGAAG
AAAATTAAAT GTTGATTAA ATAGATCACC
AAACTCTCCT CCGGATTTCC TGTCTCTTTT TCCAGAAGTT AGCACCTTTC
TTTTAATTAA CAACATAATT TATCTAGTGG
641 AGCTAGTTTC AGAGTTACCA TGTACGTATT CCACTAGCTG GGTTCTGTAT
TTCAGTTCTT TCGATACGGC TTAGGGTAAT
TCGATCAAAG TCTCAATGGT ACATGCATAA GGTGATCGAC CCAAGACATA
AAGTCAAGAA AGCTATGCCG AATCCCATTA
721 GTCAGTACAG GAAAAAACT GTGCAAGTGA GCACCTGATT CCGTTGCCTT
GGCTTAACTC TAAAGCTCCA TGTCTGGGC

```

*FIG. 18 (CONTINUED 2).*

CAGTCATGTC CTTTTTTTGA CACGTTCACT CGTGGACTION GGCAACGGAA  
CCGAATTGAG ATTTCGAGGT ACAGGACCCG

801 CTAAAATCGT ATAAAATCTG GATTTTTTTN TTTTTTTTG CGCATATTCA  
CATATGTAAA CCAGAACATT CTATGTACTA  
GATTTTAGCA TATTTTAGAC CTAAAAAAN AAAAAAAAC GCGTATAAGT  
GTATACATTT GGTCTTGTA GATACATGAT

881 CAAACCTGGT TTTTAAAAAG GAACTATGTT GCTATGAATT AAACCTGTGT  
CGTGCTGATA GGACAGACTG GATTTTTTCAT  
GTTTGGACCA AAAATTTTTTC CTTGATACAA CGATACTTAA TTTGAACACA  
GCACGACTAT CCTGTCTGAC CTAAAAAGTA

-3

&lt;-----

961 ATTTCTTATT AAAATTTCTG CCATTTAGAA GAAGAGAACT ACATTCATGG  
TTTGGAAAGAG ATAAACCTGA AAAGAAGAGT  
TAAAGAATAA TTTTAAAGAC GGTAATCTT CTTCTCTTGA TGTAAGTACC  
AAACCTTCTC TATTTGGACT TTTCTTCTCA

-3

1041 GGCCTTATCT TCACTTTATC GATAAGTCAG TTTATTTGTT TCATTGTGTA  
CATTTTTATA TTCTCCTTTT GACATTATAA  
CCGGAATAGA AGTGAAATAG CTATTCAGTC AAATAAACAA AGTAACACAT  
GTAAAAATAT AAGAGGAAAA CTGTAATATT

-3

1121 CTGTTGGCTT TTCTAATCTT GTTAAATATA TCTATTTTTA CCAAAGGTAT  
TTAATATTCT TTTTTATGAC AACTTAGATC  
GACAACCGAA AAGATTAGAA CAATTTATAT AGATAAAAAT GGTTCCTATA  
AATTATAAGA AAAAATACTG TTGAATCTAG

1201 AACTATTTTT AGCTTGGTAA ATTTTCTTAA ACACAATTGT TATAGCCAGA  
GGAACAAAGA TGATATAAAA TATTGTTGCT  
TTGATAAAAA TCGAACCATT TAAAAAGATT TGTGTTAACA ATATCGGTCT  
CCTTGTTTCT ACTATATTTT ATAACAACGA

1281 CTGACAAAAA TACATGTATT TCATTCTCGT ATGGTGCTAG AGTTAGATTA  
ATCTGCATTT TAAAAAACTG AATTGGAATA  
GACTGTTTTT ATGTACATAA AGTAAGAGCA TACCACGATC TCAATCTAAT  
TAGACGTAAA ATTTTGTGAC TTAACCTTAT

1361 GAATTGGTAA GTTGCAAAGA CTTTTTGAAA ATAATTAAAT TATCATATCT  
TCCATTCCCTG TTATTGGAGA TGAAAATAAA  
CTTAACCATT CAACGTTTCT GAAAAACTTT TATTAATTTA ATAGTATAGA  
AGGTAAGGAC AATAACCTCT ACTTTTATTT

1441 AAGCAACTTA TGAAAGTAGA CATTTCAGATC CAGCCATTAC TAACCTATTC  
CTTTTTTGGG GAAATCTGAG CCTAGCTCAG  
TTCGTTGAAT ACTTTCATCT GTAAGTCTAG GTCGGTAATG ATTGGATAAG  
GAAAAAACC CTTTAGACTC GGATCGAGTC

*FIG. 18 (CONTINUED 3).*

1521 AAAAACATAA AGCACCTTGA AAAAGACTTG GCAGCTTCCT GATAAAGCGT  
GCTGTGCTGT GCAGTAGGAA CACATCCTAT  
TTTTTGTATT TCGTGGAAC TTTTCTGAAC CGTCGAAGGA CTATTTCGCA  
CGACACGACA CGTCATCCTT GTGTAGGATA

1601 TTATTGTGAT GTTGTGGTTT TATTATCTTA AACTCTGTTC CATACTTG  
TATAAATACA TGGATATTTT TATGTACAGA  
AATAACACTA CAACACCAAA ATAATAGAAT TTGAGACAAG GTATGTGAAC  
ATATTTATGT ACCTATAAAA ATACATGTCT

1681 AGTATGTCTC TTAACCAGTT CACTTATTGT ACCTGG  
TCATACAGAG AATTGGTCAA GTGAATAACA TGGACC

*FIG. 19.* DNA and polypeptide sequence used for mammalian cell expression

```

+1      m s l f g l l l l t s a l a g q r
1  GGATCCAAAA TGAGCCTCTT CGGGCTTCTC CTGCTGACAT CTGCCCTGGC CGGCCAGAGA

+1  q g t q a E S N L S S K F Q F S S N K E
61  CAGGGGACTC AGGCGGAATC CAACCTGAGT AGTAAATTC AGTTTCCAG CAACAAGGAA

+1  Q N G V Q D P Q H E R I I T V S T N G S
121 CAGAACGGAG TACAAGATCC TCAGCATGAG AGAATTATTA CTGTGTCTAC TAATGGAAGT

+1  I H S P R F P H T Y P R N T V L V W R L
181 ATTCACAGCC CAAGGTTTCC TCATACTTAT CCAAGAAATA CGGTCTTGGT ATGGAGATTA

+1  V A V E E N V W I Q L T F D E R F G L E
241 GTAGCAGTAG AGGAAAATGT ATGGATACAA CTTACGTTTG ATGAAAGATT TGGGCTTGAA

+1  D P E D D I C K Y D F V E V E E P S D G
301 GACCCAGAAG ATGACATATG CAAGTATGAT TTTGTAGAAG TTGAGGAACC CAGTGATGGA

+1  T I L G R W C G S G T V P G K Q I S K G
361 ACTATATTAG GGCGCTGGTG TGGTTCTGGT ACTGTACCAG GAAAACAGAT TTCTAAAGGA

+1  N Q I R I R F V S D E Y F P S E P G F C
421 AATCAAATTA GGATAAGATT TGTATCTGAT GAATATTTTC CTCTGAACC AGGGTCTGTC

+1  I H Y N I V M P Q F T E A V S P S V L P
481 ATCCACTACA ACAATTGTCAT GCCACAATTC ACAGAAGCTG TGASTCCTTC AGTGCTACCC

+1  P S A L P L D L L N N A I T A F S T L E
541 CCTTCAGCTT TGCCACTGGA CTTGCTTAAT AATGCTATAA CTGCCTTTAG TACCTTGGA

+1  D L I R Y L E P E R W Q L D L E D L Y R
601 GACCTTATTC GATATCTTGA ACCAGAGAGA TGGCAGTTGG ACTAGAAGA TCTATATAGG

+1  P T W Q L L G K A F V F G R K S R V V D
661 CCAACTTGGC AACTTCTTGG CAAGGCTTTT GTTTTGGAA GAAATCCAG AGTGGTGGAT

+1  L N L L T E E V R L Y S C T P R N F S V
721 CTGAACCTTC TAACAGAGGA GGTAAGATTA TACAGCTGCA CACCTCGTAA CTTCTCAGT

+1  S I R E E L K R T D T I F W P G C L L V
781 TCCATAAGGG AAGAACTAAA GAGAACCGAT ACCATTTTCT GGCCAGGTTG TCTCCTGGTT

+1  K R C G G N C A C C L H N C N E C Q C V
841 AAACGCTGTG GTGGGAAC TGCTGTGTGT CTCCACAATT GCAATGAATG TCAATGTGTC

+1  P S K V T K K Y H E V L Q L R P K T G V
901 CCAAGCAAAG TTAATAAAAA ATACCACGAG GTCCTTCAGT TGAGACCAA GACCGGTGTC

+1  R G L H K S L T D V A L E H H E E C D C
961 AGGGGATTGC ACAATCACT CACCGACGTG GCCCTGGAGC ACCATGAGGA GTGTGACTGT

+1  V C R G S T G G S R G P F E G K P I P N
1021 GTGTGCAGAG GGAGCACAGG AGGATCTAGA GGGCCCTTGG AAGGTAAGCC TATCCCTAAC

+1  P L L G L D S T R T G H H H H H H
1081 CCTCTCCTCG GTCTCGATTC TACGCGTACC GGTCACTCCT ACCATCACCA TTGA

```

*FIG. 20.* DNA and polypeptide sequence used for baculovirus/insect cell expression

1 GAATTCAAAG GCCTGTATTT TACTGTTTTT GTAACAGTTT TGTAATAAAA AAACCTATAA  
 +3 m k f l v n v a l v f m v v y i s y i  
 61 ATATGAAATT CTTAGTCAAC GTTGCCCTTG TTTTATGGT CGTATACATT TCTTACATCT  
 +3 y a D P E S H H H H H H E S N L S S K F  
 121 ATGCGGATCC GGAGTCTCAC CATCACCACC ATCATGAATC CAACCTGAGT AGTAAATTCC  
 +3 Q F S S N K E Q N G V Q D P Q H E R I I  
 181 AGTTTTCAG CAACAAGGAA CAGAACGGAG TACAAGATCC TCAGCATGAG AGAATTATTA  
 +3 T V S T N G S I H S P R F P H T Y P R N  
 241 CTGTGTCTAC TAATGGAAGT ATTCACAGCC CAAGGTTTCC TCATACTTAT CCAAGAAATA  
 +3 T V L V W R L V A V E E N V W I Q L T F  
 301 CGGTCTTGGT ATGGAGATTA GTAGCAGTAG AGGAAAATGT ATGGATACAA CTTACGTTTG  
 +3 D E R F G L E D P E D D I C K Y D F V E  
 361 ATGAAAGATT TGGGCTTGAA GACCCAGAAG ATGACATATG CAAGTATGAT TTTGTAGAAG  
 +3 V E E P S D G T I L G R W C G S G T V P  
 421 TTGAGGAACC CAGTGATGGA ACTATATTAG GGCCTGGTG TGGTCTGGT ACTGTACCAG  
 +3 G K Q I S K G N Q I R I R F V S D E Y F  
 481 GAAAACAGAT TTCTAAAGGA AATCAAATTA GGATAAGATT TGTATCTGAT GAATATTTTC  
 +3 P S E P G F C I H Y N I V M P Q F T E A  
 541 CTTCTGAACC AGGTTCTGC ATCCACTACA ACATTGTCAT GCCACAATTC ACAGAAGCTG  
 +3 V S P S V L P P S A L P L D L L N N A I  
 601 TGAGTCCTTC AGTGCTACCC CCTTCAGCTT TGCCACTGGA CCTGCTTAAT AATGCTATAA  
 +3 T A F S T L E D L I R Y L E P E R W Q L  
 661 CTGCCTTTAG TACCTGGAA GACCTTATTC GATATCTTGA ACCAGAGAGA TGGCAGTTGG  
 +3 D L E D L Y R P T W Q L L G K A F V F G  
 721 ACTTAGAAGA TCTATATAGG CCAACTTGGC AACTTCTTGG CAAGGCTTTT GTTTTTGGAA  
 +3 R K S R V V D L N L L T E E V R L Y S C  
 781 GAAAATCCAG AGTGGTGGAT CTGAACCTTC TAACAGAGGA GGTAAGATTA TACAGCTGCA  
 +3 T P R N F S V S I R E E L K R T D T I F  
 841 CACCTCGTAA CTTCTCAGTG TCCATAAGGG AAGAACTAAA GAGAACCGAT ACCATTTTCT  
 +3 W P G C L L V K R C G G N C A C C L H N  
 901 GGCCAGGTTG TCTCTGGTT AAACGCTGTG GTGGGAAC TGCTGTGTGT CTCCACAATT  
 +3 C N E C Q C V P S K V T K K Y H E V L Q  
 961 GCAATGAATG TCAATGTGTC CCAAGCAAAG TTAATAAAAA ATACCACGAG GTCCTTCAGT  
 +3 L R P K T G V R G L H K S L T D V A L E  
 1021 TGAGACCAAA GACCGGTGTC AGGGGATTGC ACAAATCACT CACCGACGTG GCCCTGGAGC  
 +3 H H E E S D C V C R G S T G G  
 1081 ACCATGAGGA GGTGACTGT GTGTGCAGAG GGAGCACAGG AGGATAGCTC TAGA

FIG. 21. DNA and polypeptide sequence used for *E. coli* expression

```

+3  Q T N S S S N N N N N N N N N L G I
1  CGCAGACTAA TTCGAGCTCG AACAAACAACA ACAATAACAA TAACAACAAC CTCGGGATCG-

+3  E G R I S E F E S N L S S K F Q F S S N
61 AGGGAAGGAT TTCAGAATTC GAATCCAACC TGAGTAGTAA ATTCCAGTTT TCCAGCAACA

+3  K E Q N G V Q D P Q H E R I I T V S T N
121 AGGAACAGAA CGGAGTACAA GATCCTCAGC ATGAGAGAAT TATTACTGTG TCTACTAATG

+3  G S I H S P R F P H T Y P R N T V L V W
181 GAAGTATTCA CAGCCCAAGG TTCCTCATA CTTATCCAAG AAATACGGTC TTGGTATGGA

+3  R L V A V E E N V W I Q L T F D E R F G
241 GATTAGTAGC AGTAGAGGAA AATGTATGGA TACAACCTAC GTTTGATGAA AGATTTGGGC

+3  L E D P E D D I C K Y D F V E V E E P S
301 TTGAAGACCC AGAAGATGAC ATATGCAAGT ATGATTTTGT AGAAGTTGAG GAACCCAGTG

+3  D G T I L G R W C G S G T V P G K Q I S
361 ATGGAAGTAT ATTAGGGCGC TGGTGTGGTT CTGGTACTGT ACCAGGAAAA CAGATTCTTA

+3  K G N Q I R I R F V S D E Y F P S E P G
421 AAGGAAATCA AATTAGGATA AGATTTGTAT CTGATGAATA TTTTCCTTCT GAACCCAGGT

+3  F C I H Y N I V M P Q F T E A V S P S V
481 TCTGCATCCA CTACAACATT GTCATGCCAC AATTCACAGA AGCTGTGAGT CCTTCAGTGC

+3  L P P S A L P L D L L N N A I T A F S T
541 TACCCCTTC AGCTTTGCCA CTGGACCTGC TTAATAATGC TATAACTGCC TTTAGTACCT

+3  L E D L I R Y L E P E R W Q L D L E D L
601 TGGAAGACCT TATTCGATAT CTTGAACCAG AGAGATGGCA GTTGGACTTA GAAGATCTAT

+3  Y R P T W Q L L G K A F V F G R K S R V
661 ATAGGCCAAC TTGGCAACTT CTTGGCAAGG CTTTGTGTTT TGGAAGAAAA TCCAGAGTGG

+3  V D L N L L T E E V R L Y S C T P R N F
721 TGGATCTGAA CCTTCTAACA GAGGAGGTAA GATTATACAG CTGCACACCT CGTAACTTCT

+3  S V S I R E E L K R T D T I F W P G C L
781 CAGTGTCAT AAGGGAAGAA CTAAAGAGAA CCGATACCAT TTTCTGGCCA GGTGTGCTCC

+3  L V K R C G G N C A C C L H N C N E C Q
841 TGGTTAAACG CTGTGGTGGG AACTGTGCCT GTTGTCTCCA CAATTGCAAT GAATGTCAAT

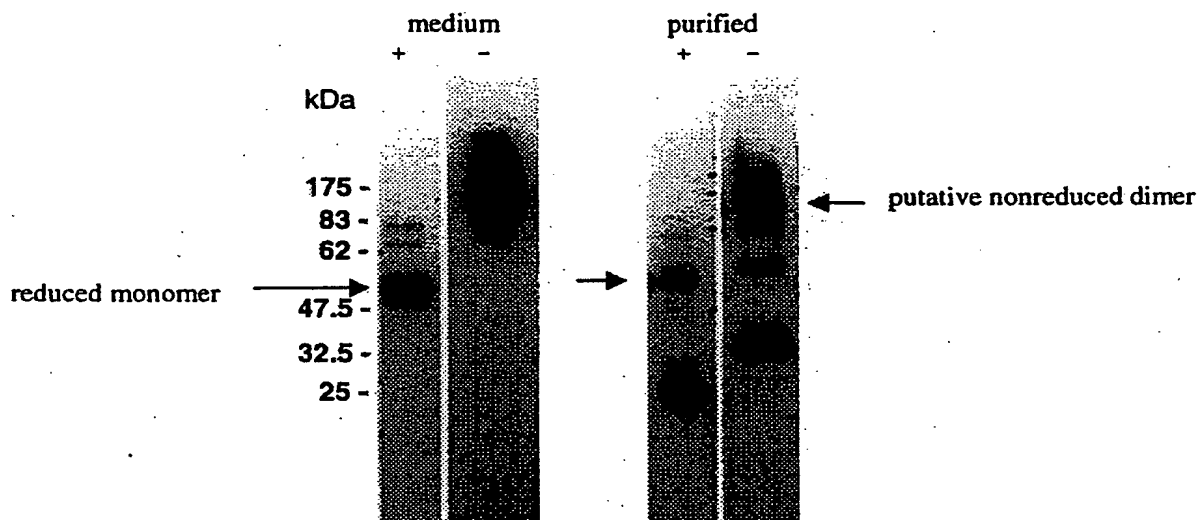
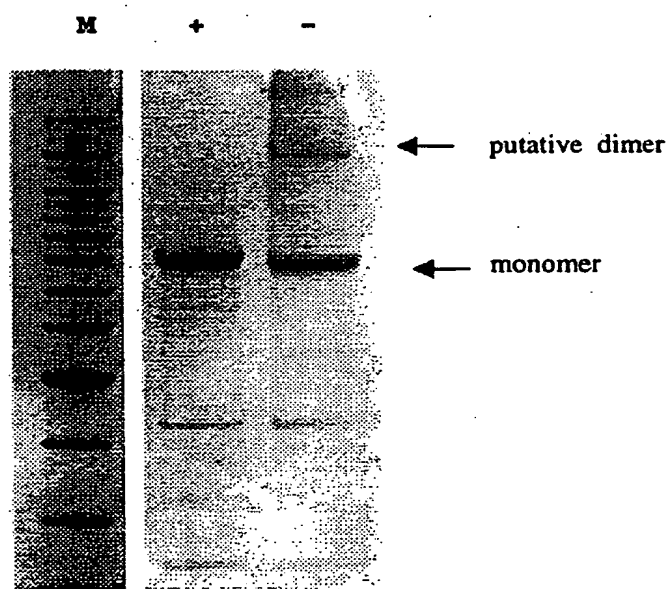
+3  C V P S K V T K K Y H E V L Q L R P K T
901 GTGTCCCAAG CAAAGTTACT AAAAAATACC ACGAGGTCCT TCAGTTGAGA CCAAAGACCG

+3  G V R G L H K S L T D V A L E H H E E C
961 GTGTCAAGGG ATTGCACAAA TCACTCACCG ACGTGGCCCT GGAGCACCAT GAGGAGTGTG

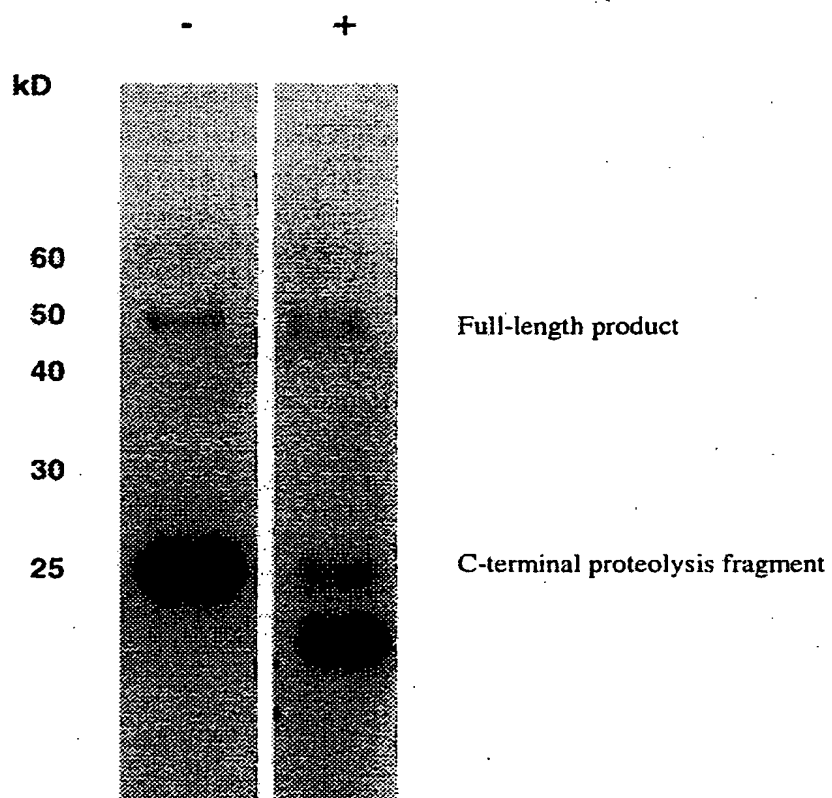
+3  D C V C R G S T G G H H H H H H *
1021 ACTGTGTGTG CAGAGGGAGC ACAGGAGGAC ATCATCACCA TCACCATTGA TCTAGAGTCG

1081 ACCTGCAGGC AAGCTT

```

**FIG. 22. Disulphide-linked dimerisation of VEGF-X****(A) Mammalian cell expression****(B) *E.coli* expression**



*FIG. 23.* Glycosylation of VEGF-X

**FIG. 24.**

DNA and polypeptide sequence used for *E.coli* expression of the PDGF-like domain

```
+3      M R G S H H H H H H G M A S M
1  AAGGAGATAT ACATATGCGG GGTTCATC ATCATCATCA TCATGGTATG GCTAGCATGA

+3 T G G O O M G R D L Y D D D D K D P G R
61 CTGGTGGACA GCAAATGGGT CGGGATCTGT ACGACGATGA CGATAAGGAT CCGGGAAGAA

+3 K S R V V D L N L L T E E V R L Y S C T
121 AATCCAGAGT GGTGGATCTG AACCTTCTAA CAGAGGAGGT AAGATTATAC AGCTGCACAC

+3 P R N F S V S I R E E L K R T D T I F W
181 CTCGTAACCT CTCAGTGTCC ATAAGGGAAG AACTAAAGAG AACCGATACC ATTTTCTGGC

+3 P G C L L V K R C G G N C A C C L H N C
241 CAGGTTGTCT CCTGGTTAAA CGCTGTGGTG GGAAGTGTGC CTGTTGTCTC CACAATTGCA

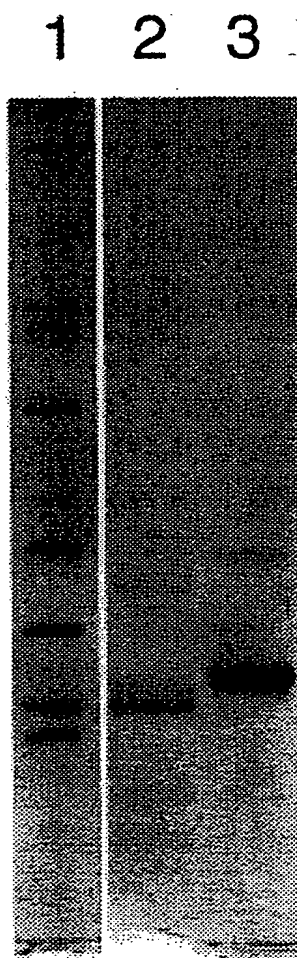
+3 N E C Q C V P S K V T K K Y H E V L Q L
301 ATGAATGTCA ATGTGTCCCA AGCAAAGTTA CTAAAAATA CCACGAGGTC CTTCAATTGA

+3 R P K T G V R G L H K S L T D V A L E H
361 GACCAAAGAC CCGTGTGAGG GGATTGCACA AATCACTCAC CGACGTGGCC CTGGAGCACC

+3 H E E C D C V C R G S T G G
421 ATGAGGAGTG TGAATGTGTG TGCAGAGGGA GCACAGGAGG ATAATGAATT CGAAGCTTGA

481 TCCGGCTGCT AACAAAGCCC
```

*FIG. 25.* Expression of PDGF domain in *E.coli*



*FIG. 26.*

DNA and polypeptide sequence used for *E.coli* expression of the CUB-like domain

```
+2   M A M D I G I N S D P E S H H H H H H
1   G G C G A T G G C C A T G G A T A T C G   G A A T T A A T T C   G G A T C C G G A G   T C T C A C C A T C   A C C A C C A T C A

+2   E S N L S S K F Q F S S N K E Q N G V Q
61  T G A A T C C A A C   C T G A G T A G T A   A A T T C C A G T T   T T C C A G C A A C   A A G G A A C A G A   A C G G A G T A C A

+2   D P Q H E R I I T V S T N G S I H S P R
121 A G A T C C T C A G   C A T G A G A G A A   T T A T T A C T G T   G T C T A C T A A T   G G A A G T A T T C   A C A G C C C A A G

+2   F P H T Y P R N T V L V W R L V A V E E
181 G T T T C C T C A T   A C T T A T C C A A   G A A A T A C G G T   C T T G G T A T G G   A G A T T A G T A G   C A G T A G A G G A

+2   N V W I Q L T F D E R F G L E D P E D D
241 A A A T G T A T G G   A T A C A A C T T A   C G T T T G A T G A   A A G A T T T G G G   C T T G A A G A C C   C A G A A G A T G A

+2   I C K Y D F V E V E E P S D G T I L G R
301 C A T A T G C A A G   T A T G A T T T T G   T A G A A G T T G A   G G A A C C C A G T   G A T G G A A C T A   T A T T A G G G C G

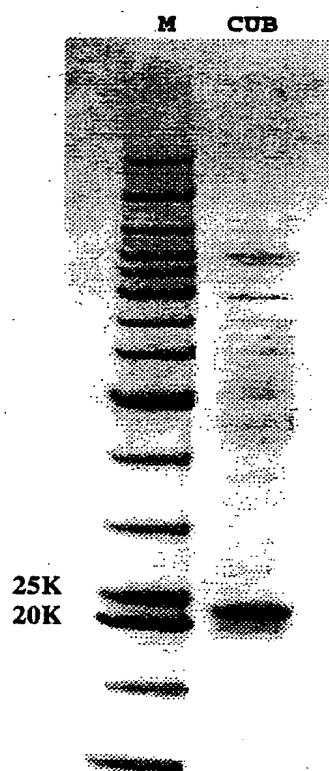
+2   W C G S G T V P G K Q I S K G N Q I R I
361 C T G G I G T G G T   T C T G G T A C T G   T A C C A G G A A A   A C A G A T T T C T   A A G G A A A T C   A A A T T A G G A T

+2   R F V S D E Y F P S E P G F C I H Y N I
421 A A G A T T T G T A   T C T G A T G A A T   A T T T T C C T T C   T G A A C C A G G G   T T C T G C A T C C   A C T A C A A C A T

+2   V M P C F T E A V
481 T G T C A T G C C A   C A A T T C A C A G   A A G C T G T G T A   G T C G A G C T C C   G T C G A C A A G C   T T G C G G C C G C

541 A C T C G A G C A C
```

*FIG. 27.* Expression of the CUB domain in *E.coli*



*FIG. 28. The Effect of Truncated VEGF-X  
(CUB domain) on HUVEC Proliferation.*

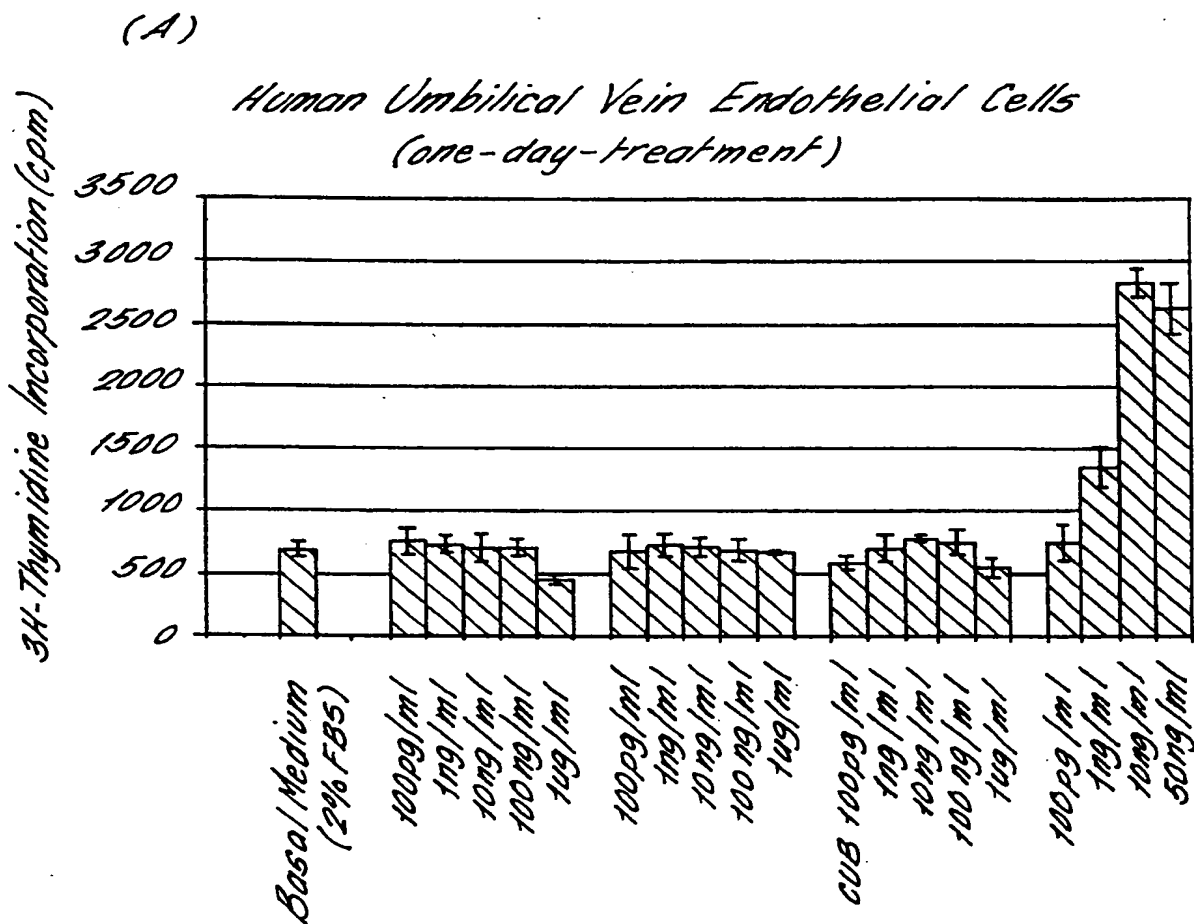


FIG. 28 (CONTINUED 1).

(B)

Human Umbilical Vein Endothelial Cells (24-hour-starving Followed by one-day-treatment)

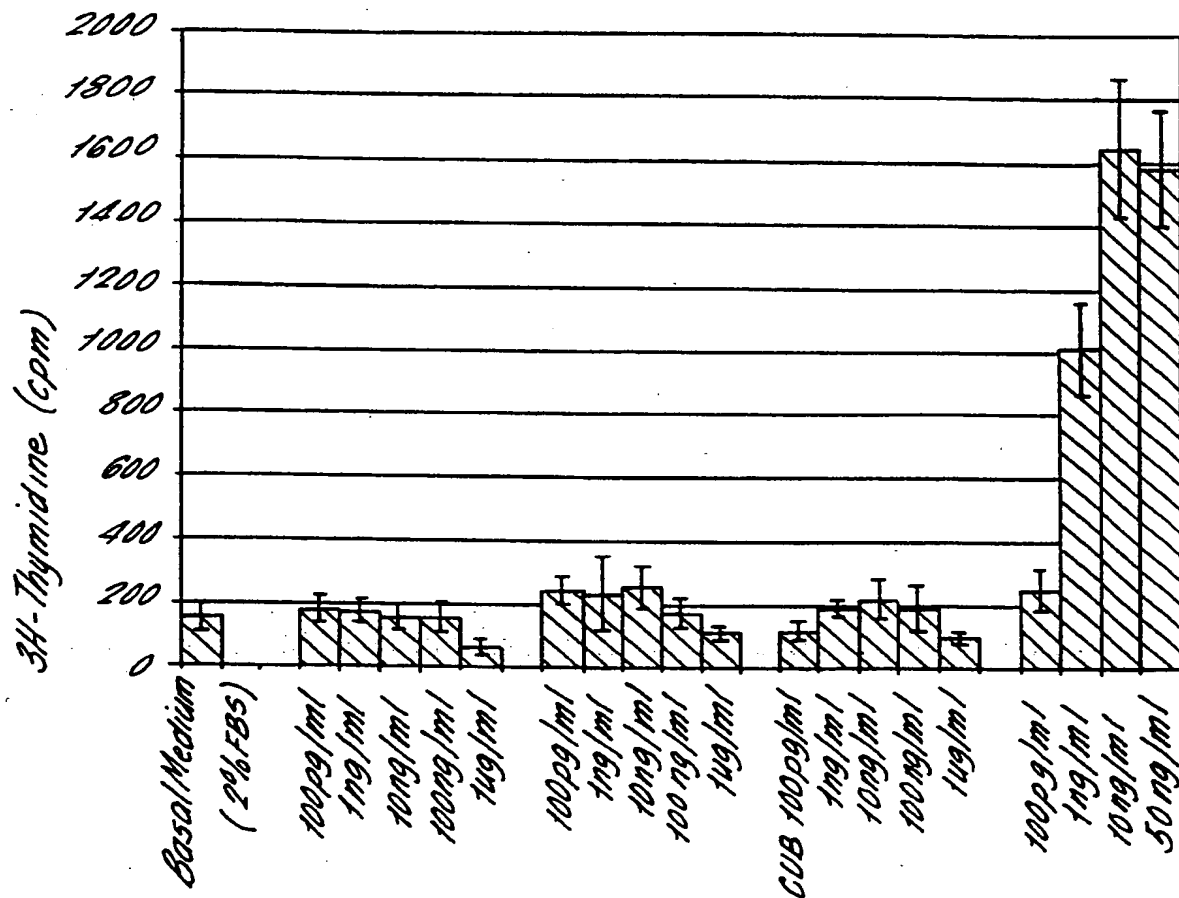


FIG. 28 (CONTINUED 2).

(C)

The effect of VEGF-A<sub>165</sub> and VEGF-X CUB domain on the proliferation of HUVEC (two-day-treatment).

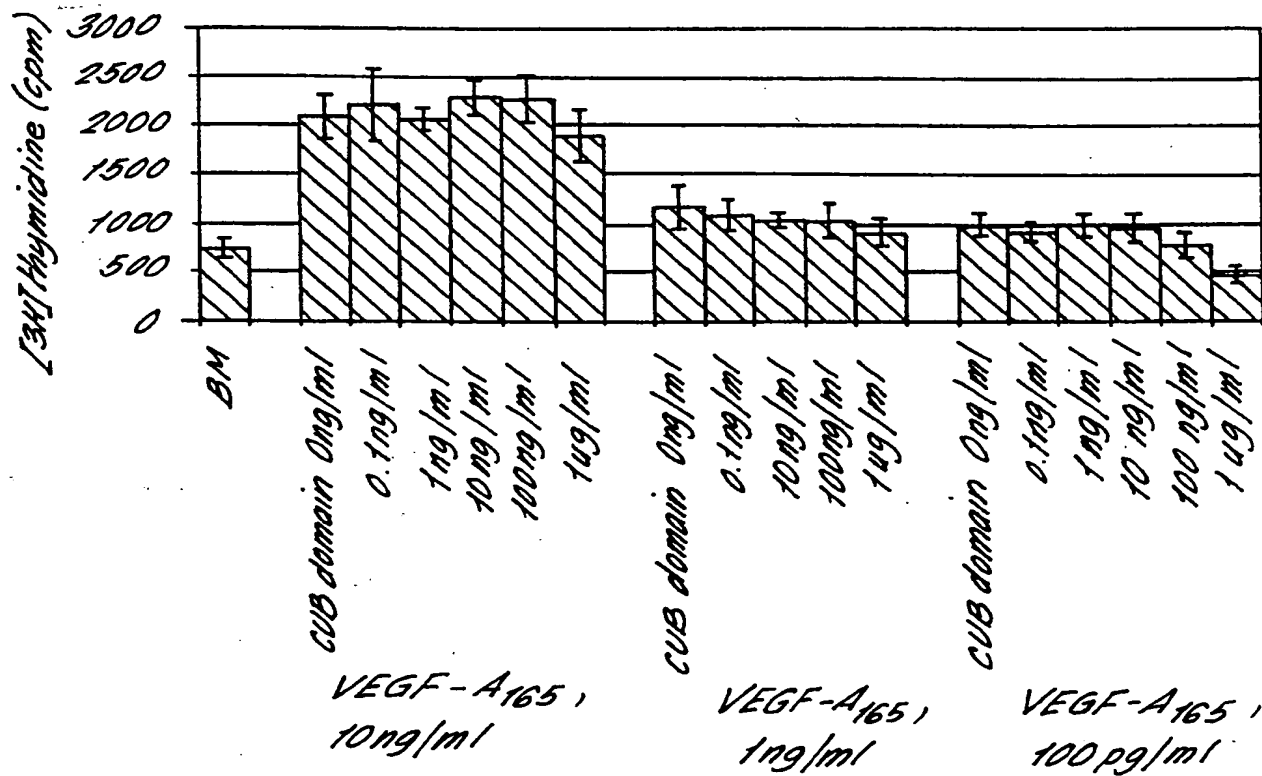




FIG. 29.  
Tissue distribution of mRNA

(A) - Normal tissues

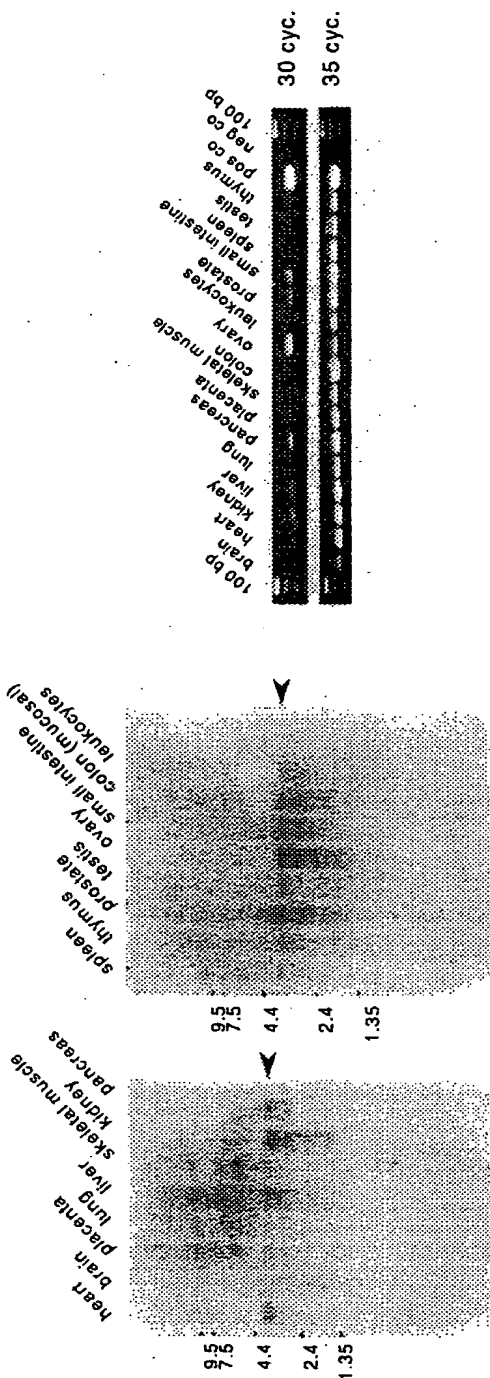
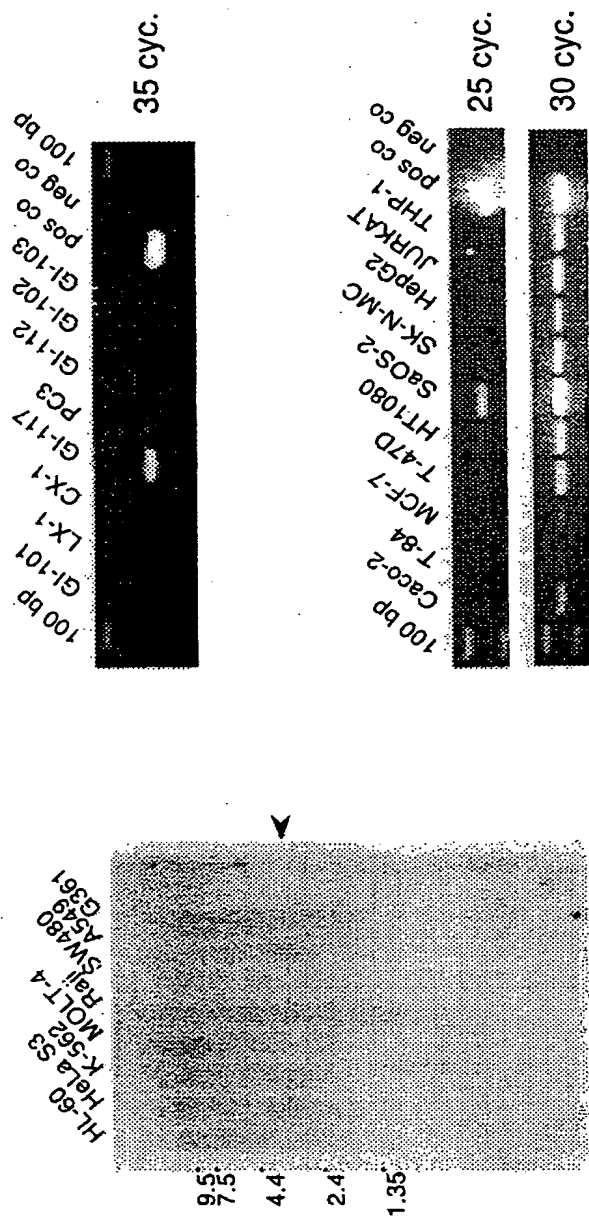


FIG. 29 (CONTINUED). (B)- Tumour tissue and cell lines



*FIG. 30.*

## Partial intron/exon structure of the VEGF-X gene

## (A) - Genomic DNA sequences of 2 exons determined by sequencing

ttctctttataccatatagtgsggagatctgaaccagGGTTCGTCATCCACTACAACATTGTCATGCCACAATTCACAGAAGCTGTG  
AGTCCTTCAGTGCTACCCCTTCAGCTTTGCCACTGGACCTGCTTAATAATGCTATAACTGCCTTTAGTACCTTGAAGACCTTAT  
TCGATATCTTGAACCAGAGAGATGGCAGTTGGACTTAGAAGATCTATATAGGCCAACTTGGCAACTTCTTGGCAAGGCTTTTGT  
TTGAAGAAAATCCAGAGTGGTGGATCTGAACCTTCTAACAGAGGAGGTAAGATTATACAGCTGCACACCTCGTAACTTCTCAGTG  
TCCATAAGGGAAGAACTAAAGAGAACCGATACCATTTTCTGGCCAGGTTGTCTCCTGGTTAAACGCTGTGGTGGAACTGTGCCTG  
TTGTCTCCACAATTGCAATGAATGTCAATGTGTCCCAAGCAAAGTTACTAAAAAATACCACGAGgttaggtatacaattttctttt  
ggttcccttcgggtattttatg:cct

aaagccagtcacagacattcggtgatttttaaaagtggcttactcttattccctttcagGTCCTTCAGTTGAGACCAAAGACCGGT  
GTCAGGGGATTGCACAAATCACTACCGACGTGGCCCTGGAGCACCATGAGGAGTGTGACTGTGTGTGCAGAGGGAGCACAGGAGG  
ATAGCCGCATCACCACCAGCAGCTCTTGCCAGAGCTGTGCAGTGCAGTGGCTGATTCTATTAGAGAACGTATGCGTTATCTCCAT  
CCTTAATCTCAGTTGTTTTCCTTCAAGGACCTTTTCATCTTCAGGATTTACAGTGCATTCTGAAAGAGGAGACATCAAACAGAATTAG  
GAGTTGTGCAACAGCTCTTTTGAAGAGGAGGCCTAAAGGACAGGAGAAAAGGTCTTCAATCGTGGAAAGAAAATTAATGTTGTATT  
AAATAGATCACCAGCTAGTTTCAGAGTTACCATGTACGTATTTCCACTAGCTGGGTTCTGTATTTTCAGTTCTTTTCGATACGGCTTAG  
GGTAATGTCAGTACAGGAAAAAACTGTGCAAGTGAGCACCTGATTCCGTTGCCTTGGCTTAACTCTAAAGCTCCATGTCCTGGGC  
CTAAAATCGTATAAAATCTGGATTTTTTTTTTTTTTTTTTGGCGCATATTCACATATGTAAACCAGAACATTCTATGTACTACAAACC  
TGGTTTTTAAAAAGGAACATATGTTGCTATGAATTAACTTGTGTCATGCTGATAGGACAGACTGGATTTTTTCATATTTCTTATTAA  
AATTTCTGCCATTTAGAAGAAGAGAACTACATTCTGTTTGGAAAGAGATAAACCTGAAAAGAAGAGTGGCCTTATCTTCACTTTA  
TCGATAAGTCAGTTTATTGTTTCATTGTGTACATTTTATATTCTCCTTTTGACATTATAACTGTTGGCTTTTCTAATCTTGTTA  
AATATATCTATTTTTACCAAAGGATTTAATATTCTTTTTTATGACAACTTAGATCAACTATTTTTAGCTTGGTAAATTTTTCTAA  
ACACAATTGTTATAGCCAGAGGAACAAAGATGATATAAAATATTGTTGCTCTGACAAAAATACATGTATTTTCATTCTCGTATGGTG  
CTAGAGTTAGATTAATCTGCATTTTAAAAAACTGAATTGGAATAGAATTGGTAAGTTGCAAAGACTTTTGAAAATAATTAAATTA  
TCATATCTTCCATTCTGTTATTGGAGATGAAAATAAAAAAGCACTTATGAAAGTAGACATTGAGATCCAGCCATTACTAACCTAT  
TCCTTTTTTGGGGAAATCTGAGCCTAGCTCAGAAAAACATAAAGCACCTTGAAAAAGACTTGGCAGCTTCTGTATAAAGCGTGCTG  
TGCTGTGCAGTAGGAACACATCTATTTATTGTGATGTTGTGGTTTTATTATCTTAACTCTGTTCCATACACTTGTAATAATACA  
TGGATATTTTTATGTACAGAAGTATGCTCTTAACCACTTCACTTATGTACTCTGGCAATTTAAAAGAAAATCAGTAAATATTT  
TGCTTGTAATAATGCTTAATATCGTGCTAGGTTATGTGGTGACTATTTGAATCAAAAATGTATTGAATCATCAATAAAAGAAATGT  
GGCTATTTTGGGGAGAAAATtatgtgtgtgtgtgctcaagatttattctctggactctgagaaaatgaaagataaa

*FIG. 30(Continued 1).*

## (B) - Location of splice sites within the cDNA sequence

1 GAATTCGCCC TTTGTTTAA ACCTTGGGAA CTGGTTCAGG TCCAGGTTT GCTTTGATCC  
 61 TTTTCAAAAA CTGGAGACAC AGAAGAGGGC TCTAGGAAAA AGTTTTGGAT GGGATTATGT  
 121 GGAAACTACC CTGCGATTCT CTGCTGCCAG AGCAGGCTCG GCGCTTCCAC CCCAGTGCAG  
 181 CCTTCCCCCTG GCGGTGGTGA AAGAGACTCG GGAGTCGCTG CTTCCAAAGT GCGCGCCGTG  
 +3 M S L F G L L L L T S  
 241 AGTGAGCTCT CACCCCAGTC AGCCAAATGA GCCTCTTCGG GCTTCTCCTG CTGACATCTG  
 +3 A L A G Q R Q G T Q A E S N L S S K F Q  
 301 CCCTGGCCGG CCAGAGACAG GGGACTCAGG CGGAATCCAA CCTGAGTAGT AAATTCAGT  
 +3 F S S N K E Q N G V Q D P Q H E R I I T  
 361 TTTCCAGCAA CAAGGAACAG AACGGAGTAC AAGATCCTCA GCATGAGAGA ATTATTACTG  
 +3 V S T N G S I H S P R F P H T Y P R N T  
 421 TGTCTACTAA TGAAGTATT CACAGCCCAA GGTTCCTCA TACTTATCCA AGAAATACGG  
 +3 V L V W R L V A V E E N V W I Q L T F D  
 481 TCTTGGTATG GAGATTAGTA GCAGTAGAGG AAAATGTATG GATACAATT ACGTTTGATG  
 +3 E R F G L E D P E D D I C K Y D F V E V  
 541 AAAGATTGG GCTTGAAGAC CCAGAAGATG ACATATGCAA GTATGATTT GTAGAAGTTG  
 +3 E E P S D G T I L G R W C G S G T V P G  
 601 AGGAACCCAG TGATGGAAT ATATTAGGGC GCTGGTGTGG TTCTGGTACT GTACCAGGAA  
 +3 K Q I S K G N Q I R I R F V S D E Y F P  
 661 AACAGATTTC TAAAGGAAAT CAAATTAGGA TAAGATTGT ATCTGATGAA TATTTTCCTT  
 +3 S E P G F C I H Y N I V M P Q F T E A V  
 721 CTGAACCAG GTTCTGCATC CACTACAACA TTGTCATGCC ACAATTCACA GAAGCTGTGA  
 +3 S P S V L P P S A L P L D L L N N A I T  
 781 GTCCTTCAGT GCTACCCCT TCAGCTTTC CACTGGACCT GCTTAATAAT GCTATAACTG  
 +3 A F S T L E D L I R Y L E P E R W Q L D  
 841 CCTTTAGTAC CTGGAAGAC CTTATTCGAT ATCTTGAACC AGAGAGATGG CAGTTGGACT  
 +3 L E D L Y R P T W Q L L G K A F V F G R  
 901 TAGAAGATCT ATATAGGCCA ACTTGGCAAC TTCTTGGCAA GGCTTTTGT TTTGGAAGAA  
 +3 K S R V V D L N L L T E E V R L Y S C T  
 961 AATCCAGAGT GTTGATCTG AACCTTCTAA CAGAGGAGT AAGATTATAC AGCTGCACAC  
 +3 P R N F S V S I R E E L K R T D T I F W  
 1021 CTCGTAACCT CTCAGTGTCC ATAAGGGAAG AACTAAAGAG AACCGATACC ATTTTCGGC  
 +3 P G C L L V K R C G G N C A C C L H N C  
 1081 CAGGTTGTCT CTGGTTAAA CGCTGTGGTG GGAAGTGTG CTGTTGTCTC CACAATGCA  
 +3 N E C Q C V P S K V T K K Y H E V L O L  
 1141 ATGAATGTCA ATGTGTCCA AGCAAAGTTA CTAAAAATA CCACGAGTC CTTCAAGTGA

*FIG. 30 (CONTINUED 2).*

+3 R P K T G V R G L H K S L T D V A L E H  
1201 GACCAAAGAC CCGTGTGAGG GGATTGCACA AATCACTCAC CGACGTGGCC CTGGAGCACC

+3 H E E C D C V C R G S T G G  
1261 ATGAGGAGTG TGA CTGTGTG TGCAGAGGGA GCACAGGAGG ATAGCCGCAT CACCACCAGC

1321 AGCTCTTGCC CAGAGCTGTG CAGTGCAGTG GCTGATTCTA TTAGAGAACG TATGCGTTAT

1381 CTCCATCCTT AATCTCAGTT GTTTGCTTCA AGGAOCTTTC ATCTTCAGGA TTTACAGTGC

1441 ATTCTGAAAG AGGAGACATC AAACAGAATT AGGAGTTGTG CAACAGCTCT TTTGAGAGGA

1501 GGCCTAAAGG ACAGGAGAAA AGGTCTTCAA TCGTGGAAAG AAAATTAAAT GTTGTATTAA

1561 ATAGATCACC AGCTAGTTTC AGAGTTACCA TGTACGTATT CCACTAGCTG GOTTCTGTAT

1621 TTCAGTTCTT TCGATACGGC TTAGGGTAAT GTCAGTACAG GAAAAAACT GTGCAAGTGA

1681 GCACCTGATT CCGTTGCCTT GCTTAACTCT AAAGCTCCAT GTCCTGGGCC TAAATCGTA

1741 TAAATCTGG ATTTTTTTTT TTTTTTTTG CTCATATTCA CATATGTAAA CCAGAACATT

1801 CTATGTACTA CAAACCTGGT TTTTAAAAAG GAACTATGTT GCTATGAATT AAATTGTGT

1861 CATGCTGATA GGACAGACTG GATTTTTCAT ATTTCTTATT AAAATTTCTG CCATTTAGAA

1921 GAAGAGAACT ACATTCATGG TTTGGAAGAG ATAAACCTGA AAAGAAGAGT GGCCTTATCT

1981 TCACTTTATC GATAAGTCAG TTTATTTGTT TCATTGTGTA CATTTTATA TTCTCCTTTT

2041 GACATTATAA CTGTTGGCTT TTCTAATCTT GTTAAATATA TCTATTTTAA CCAAAGGTAT

2101 TTAATATTCT TTTTATGAC AACTTAGATC AACTATTTTT AGCTTGGTAA ATTTTCTAA

2161 ACACAATTGT TATAGCCAGA GGAACAAAGA TGATATAAAA TATTGTTGCT CTGACAAAAA

2221 TACATGTATT TCATTCTCGT ATGGTGCTAG AGTTAGATTA ATCTGCATT TAAAAACTG

2281 AATTGGAATA GAATTGGTAA GTTGCAAAGA CTTTTTGAA ATAATTAAAT TATCATATCT

2341 TCCATTCCTG TTATTGGAGA TGAAAATAAA AAGCAACTTA TGAAAGTAGA CATTGAGATC

2401 CAGCCATTAC TAACCTATTC CTTTTTGGG GAAATCTGAG CCTAGCTCAG AAAACATAA

2461 AGCACCTGA AAAAGACTTG GCAGCTTCCT GATAAAGCGT GCTGTGCTGT GCAGTAGGAA

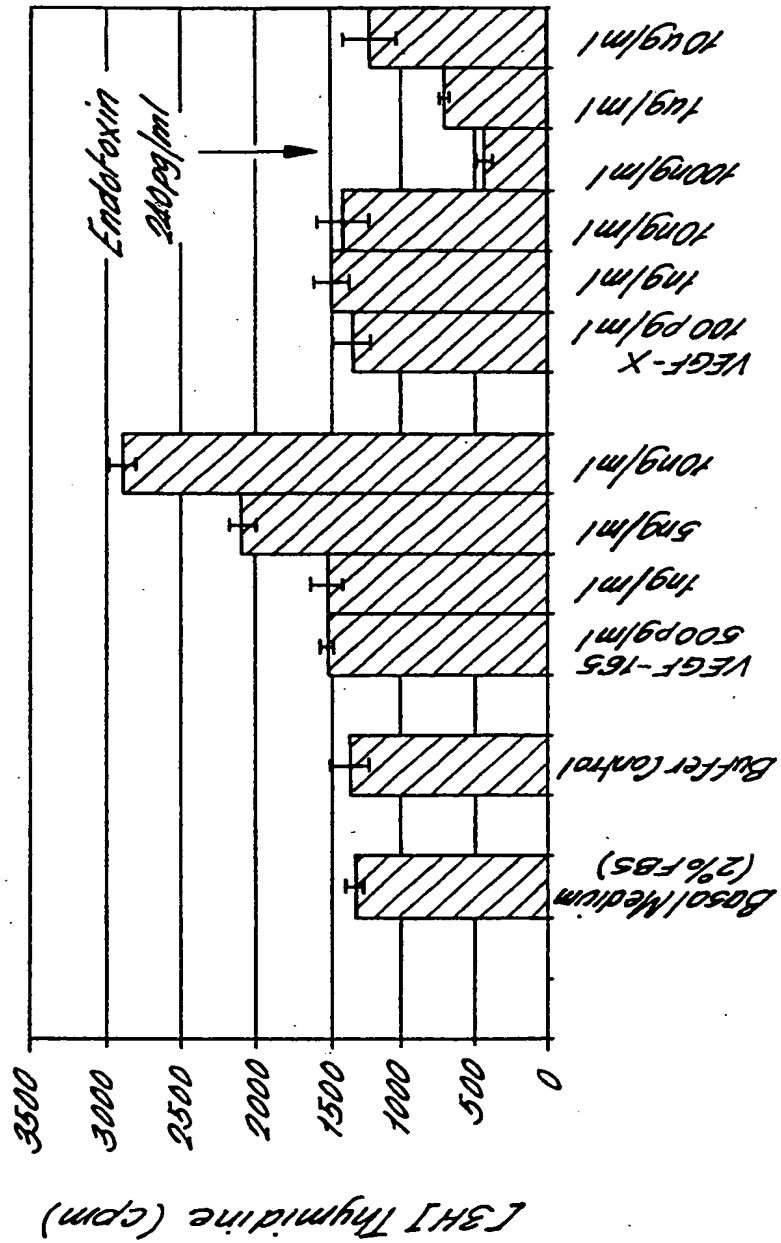
2521 CACATCCTAT TTATTGTGAT GTTGTGGTTT TATTATCTTA AACTCTGTT CATACTTG

2581 TATAAATACA TGGATATTTT TATGTACAGA AGTATGTCTC TTAACCAGTT CACTTATTGT

2641 ACCTGGAAGG GCGAATTCTG CAGATATC

FIG. 31.

The Effect of Fl-VEGF-X on HUVEC Proliferation:  
(24-hour serum starvation followed by  
one day-treatment)





**FIG. 33.**  
*The Combined Effect of CUB Domain and Human Recombinant bFGF on HUVEC Proliferation: (24-hour serum starvation followed by two-day-treatment).*

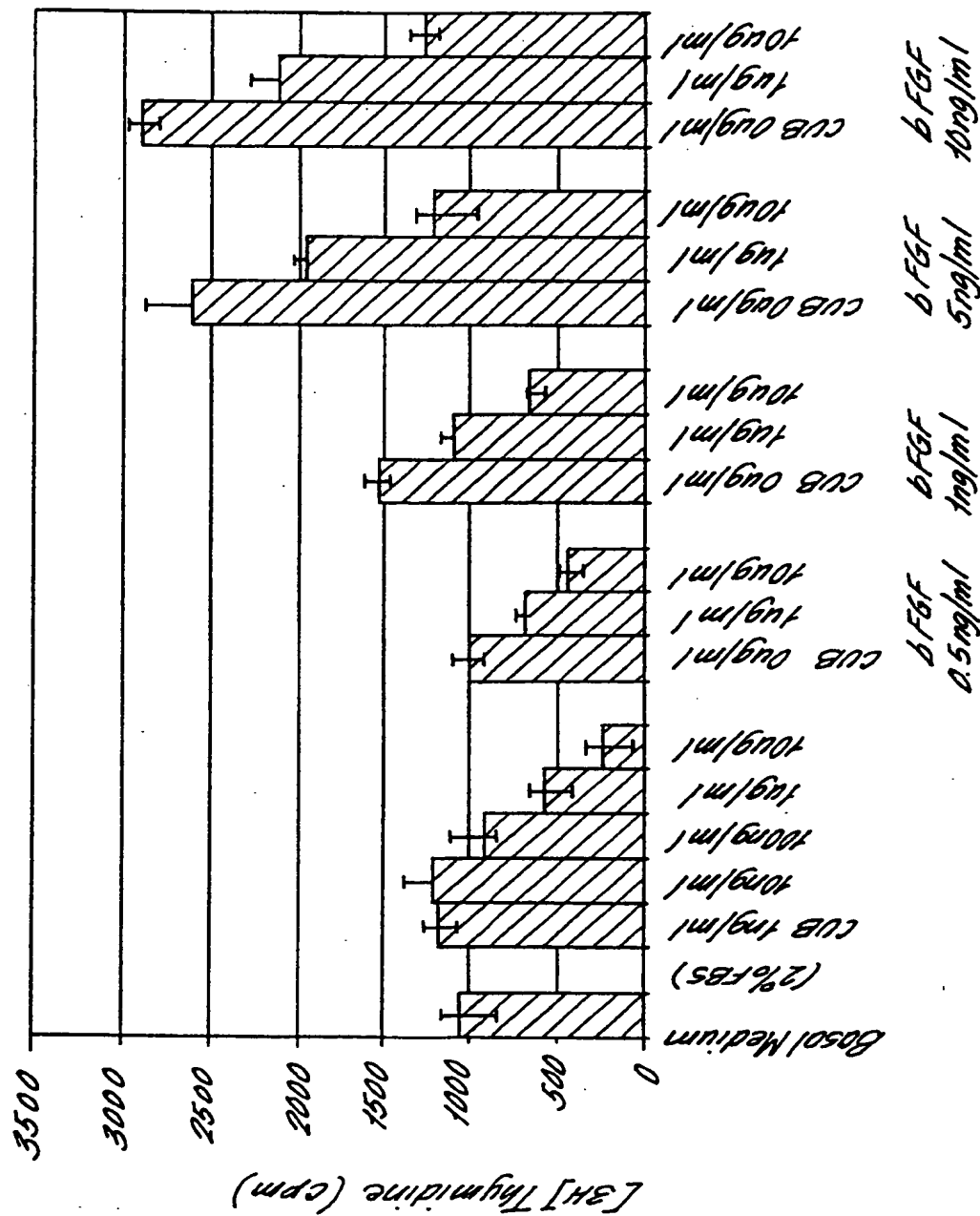




FIG. 34.  
LDH Assay For Testing Cytotoxicity of CUB Domain or  
CUB Domain with rhVEGF<sub>165</sub>

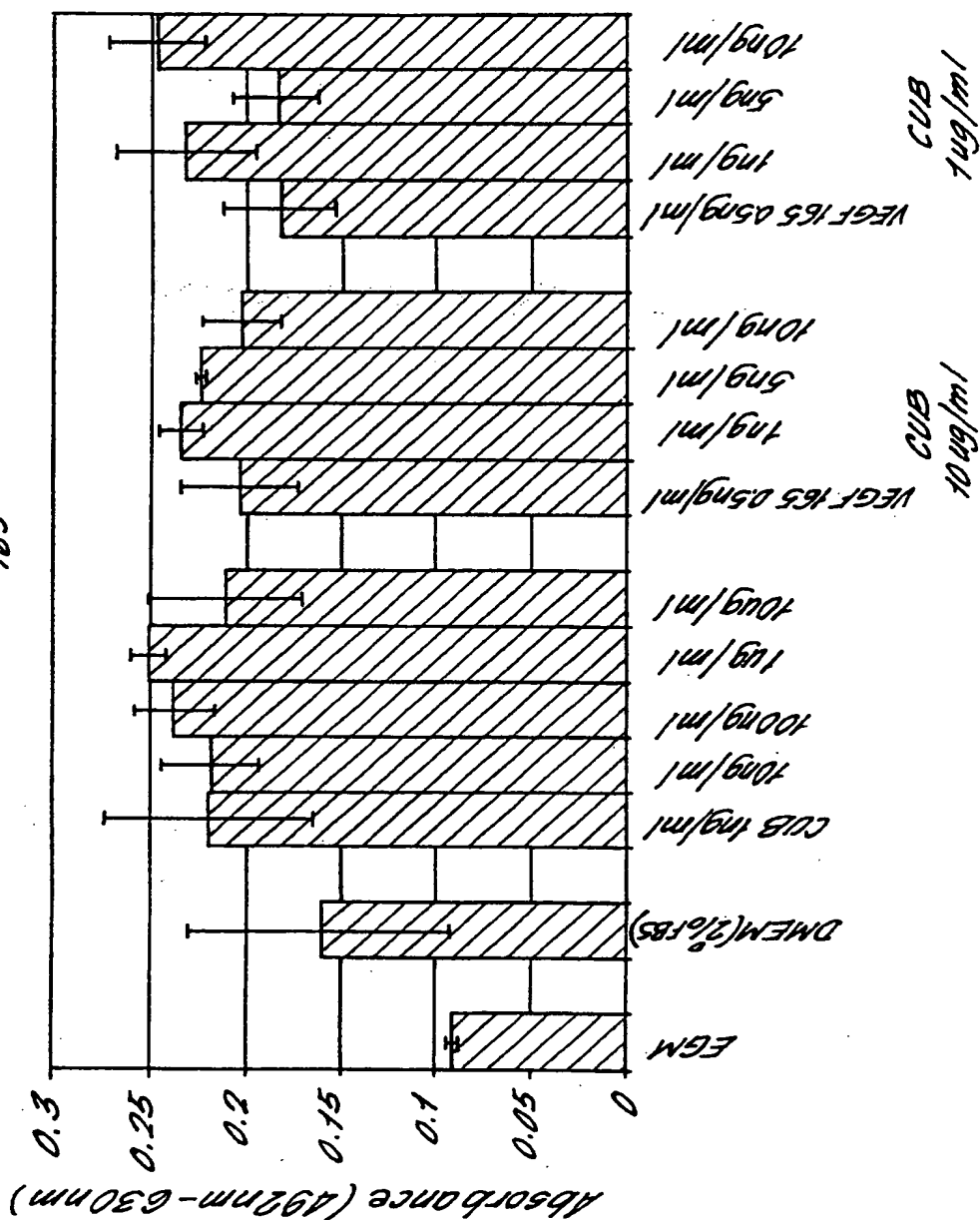
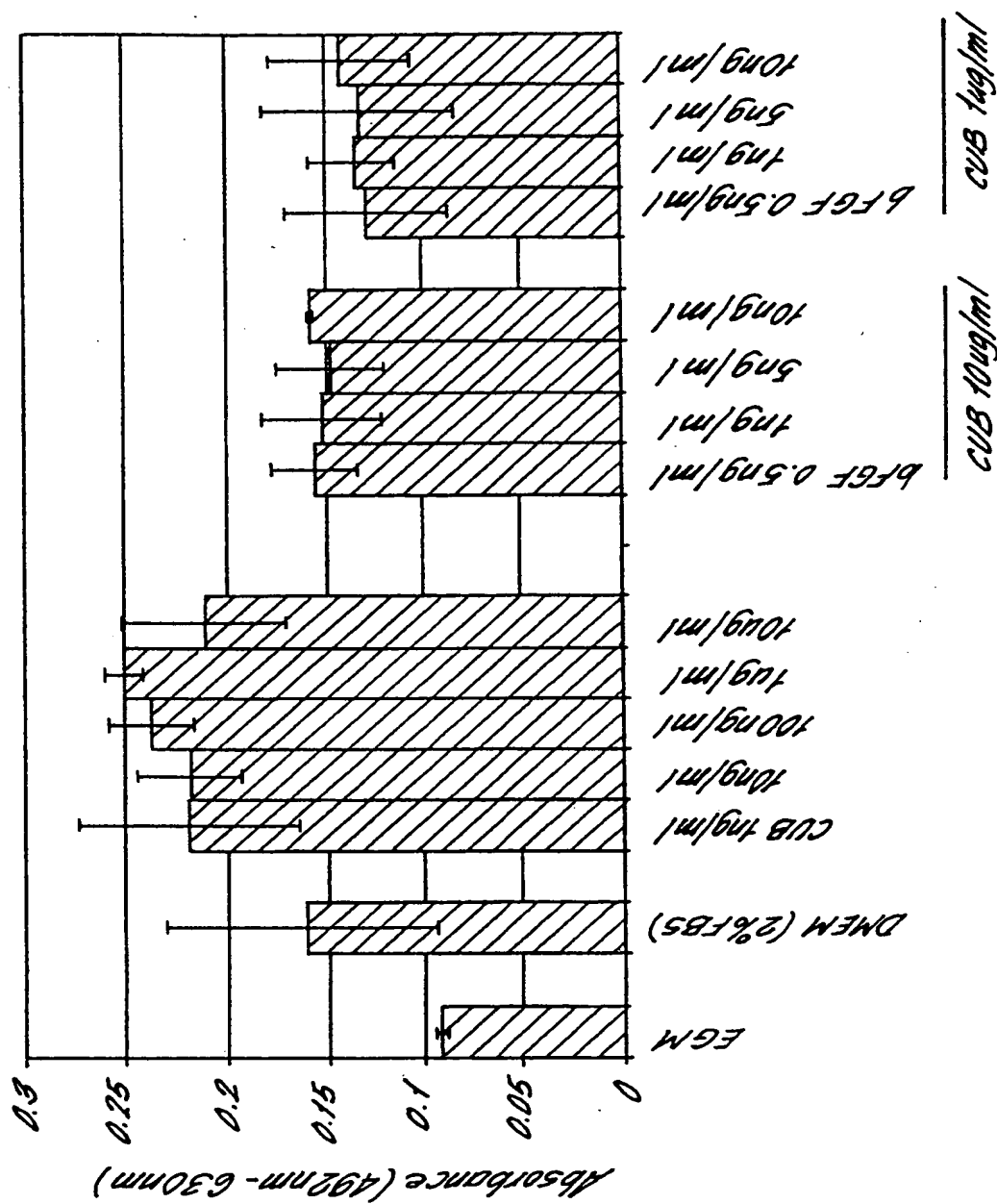


FIG. 35.  
LDH Assay For Testing Cytotoxicity of CUB Domain or  
CUB Domain with rh-bFGF



Applicant's or agent's file reference	B0192/7011W0	International application No. PCT/US99/30503
--	--------------	---

**INDICATIONS RELATING TO DEPOSITED MICROORGANISM  
OR OTHER BIOLOGICAL MATERIAL**

(PCT Rule 13bis)

<b>A.</b> The indications made below relate to the deposited microorganism or other biological material referred to in the description on page <u>21</u> . line <u>15-16</u>	
<b>B. IDENTIFICATION OF DEPOSIT</b> <span style="float: right;">Further deposits are identified on an additional sheet <input type="checkbox"/></span>	
Name of depositary institution BELGIAN COORDINATED COLLECTIONS OF MICROORGANISMS (BCCM) <sup>TM</sup> LABORATORIUM VOOR MOLECULAIRE BIOLOGIE - PLASMIDENCOLLECTIE (LMBP)	
Address of depositary institution (including postal code and country)  Universiteit Gent K.L. Ledeganckstraat 35 B-9000 Gent, Belgium	
Date of deposit  20 December 1999 (20.12.99)	Accession Number  LMBP 3991
<b>C. ADDITIONAL INDICATIONS</b> (leave blank if not applicable) <span style="float: right;">This information is continued on an additional sheet <input type="checkbox"/></span>	
<b>D. DESIGNATED STATES FOR WHICH INDICATIONS ARE MADE</b> (if the indications are not for all designated States)	
<b>E. SEPARATE FURNISHING OF INDICATIONS</b> (leave blank if not applicable)	
The indications listed below will be submitted to the International Bureau later (specify the general nature of the indications e.g., "Accession Number of Deposit")	

<p style="text-align: center;">For receiving Office use only</p> <p><input type="checkbox"/> This sheet was received with the international application</p> <p>Authorized officer</p>	<p style="text-align: center;">For International Bureau use only</p> <p><input checked="" type="checkbox"/> This sheet was received by the International Bureau on: <b>19 APRIL 2000 (19.04.00)</b></p> <p>Authorized officer <b>Ellen Moyse</b></p>
---	--

**BELGIAN COORDINATED COLLECTIONS OF MICROORGANISMS - BCCM™  
LMBP-COLLECTION**

Page 1 of Form BCCM™/LMBP/BP/4/99-23 Receipt in the case of an original deposit

**Budapest Treaty on the International Recognition of the Deposit of Microorganisms for  
the Purposes of Patent Procedure**

**Receipt in the case of an original deposit issued pursuant to Rule 7.1 by the  
International Depositary Authority BCCM™/LMBP identified at the bottom of next page**

***International Form BCCM™/LMBP/BP/4/99-23***

**To : Name of the depositor : Janssen Pharmaceutica N.V.**

**Address : Turnhoutseweg 30  
B-2340 Beerse  
Belgium**

**I. Identification of the microorganism:**

**I.1 Identification reference given by the depositor:**

**VEGF-X CUB PET22b**

**I.2 Accession number given by the International Depositary Authority:**

**LMBP 3991**

**BELGIAN COORDINATED COLLECTIONS OF MICROORGANISMS - BCCM™  
LMBP-COLLECTION**

Page 2 of Form BCCM™/LMBP/BP/4/99-23 Receipt in the case of an original deposit

**II. Scientific description and/or proposed taxonomic designation**

The microorganism identified under I above was accompanied by:

(mark with a cross the applicable box(es))

- |                                    |   |  |
|------------------------------------|---|--|
| - a scientific description         | yes <input checked="" type="checkbox"/> | no <input type="checkbox"/>            |
| - a proposed taxonomic designation | yes <input type="checkbox"/>            | no <input checked="" type="checkbox"/> |

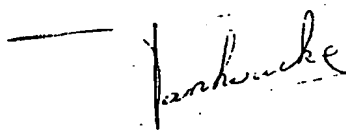
**III. Receipt and acceptance**

This International Depositary Authority accepts the microorganism identified under I above, which was received by it on (date of original deposit) : December 20, 1999

**IV. International Depositary Authority**

Belgian Coordinated Collections of Microorganisms (BCCM™)  
Laboratorium voor Moleculaire Biologie - Plasmidencollectie (LMBP)  
Universiteit Gent  
K.L. Ledeganckstraat 35  
B-9000 Gent, Belgium

Signature(s) of person(s) having the power to represent the International Depositary Authority or of authorized official(s):



Date : January 12, 2000

Martine Vanhoucke  
BCCM/LMBP curator

## BELGIAN COORDINATED COLLECTIONS OF MICROORGANISMS - BCCM™

## LMBP-COLLECTION

Page 1 of Form BCCM™/LMBP/BP/9/99-23 Viability statement

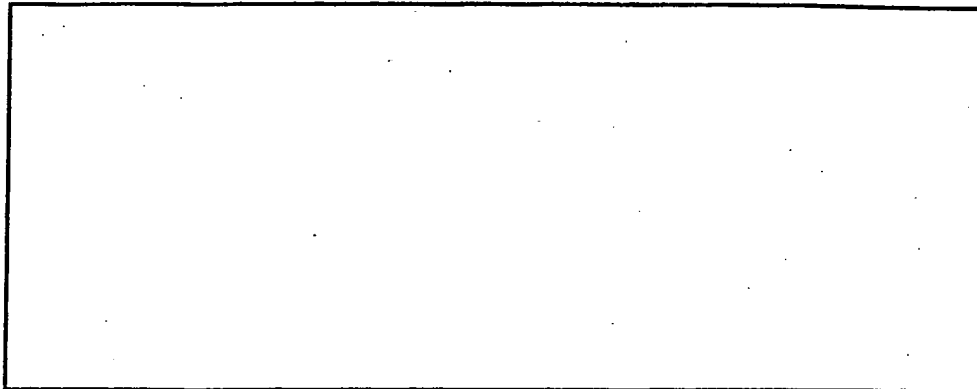
**Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure****Viability statement issued pursuant to Rule 10.2 by the International Depositary Authority BCCM™/LMBP identified on the following page*****International Form BCCM™/LMBP/BP/9/99-23*****To : Party to whom the viability statement is issued:****Name : Dr Filip De Corte****Address : Janssen Pharmaceutica N.V.  
Turnhoutseweg 30  
B-2340 Beerse  
Belgium****I. Depositor:****I.1 Name : Janssen Pharmaceutica N.V.****I.2 Address : Turnhoutseweg 30  
B-2340 Beerse  
Belgium****II. Identification of the microorganism:****II.1 Accession number given by the International Depositary Authority:****LMBP 3991****II.2 Date of the original deposit (or where a new deposit or a transfer has been made, the most recent relevant date) : December 20, 1999****III. Viability statement.****The viability of the microorganism identified under II above was tested on****: January 11, 2000****(Give date. In the cases referred to in Rule 10.2(a)(ii) and (iii), refer to the most recent viability test).****On that date, the said microorganism was: (mark the applicable box with a cross)**☒ **viable**☐ **no longer viable**

**BELGIAN COORDINATED COLLECTIONS OF MICROORGANISMS - BCCM™  
LMBP-COLLECTION**

Page 2 of Form BCCM™/LMBP/BP/9/99-23 Viability statement

**IV. Conditions under which the viability test has been performed:**

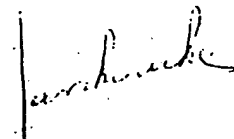
(Fill in if the information has been requested and if the results of the test were negative).



**V. International Depositary Authority**

Belgian Coordinated Collections of Microorganisms (BCCM™)  
Laboratorium voor Moleculaire Biologie - Plasmidencollectie (LMBP)  
Universiteit Gent  
K.L. Ledeganckstraat 35  
B-9000 Gent, Belgium

Signature(s) of person(s) having the power to represent the International Depositary Authority or of authorized official(s):



Date : January 12, 2000

Martine Vanhoucke  
BCCM/LMBP curator